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Table of Contents and Index

1909

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vol. 8-11
1909-12

CONTENTS

INDEX

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OF THE

Southern California Academy of Sciences

LOS ANGELES, CALIFORNIA, U. S. A.

JANUARY, 1909

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BULLETIN

OF THE

Southern California Academy of Sciences

COMMITTEE ON PUBLICATION:

Holdridge Ozro Collins, LL. D., Chairman.
Anstruther Davidson, C. M., M. D. William H. Knight.

CONTENTS:

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Southern California Academy of Sciences

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Editorial

With this number we commence Volume eight of the Bulletin, and it has been decided by the Directors of the Academy that future publications shall be regularly issued in July and January.

Six years ago this month the first number of Volume I was sent to members. That number was a small pamphlet of only twelve pages, less than six of which were devoted to scientific matters. It was tentative only, as there were grave doubts that the time was ripe for such a venture in this new city. Happily all fears as to the success of the project proved groundless, for the Bulletins met with an immediate welcome by the members, and from the first number they were very favorably received by the foreign scientific Bodies to which they were sent.

California presents a very rich, and in some features an unique field for scientific investigation. The great cañons, or gashes in her lofty mountain chains; the fossil trees, so closely related to our gigantic conifers, washed out of the tufa which was discharged from Mt. St. Helena before its extinction as a volcano, and now forming the petrified forest of Napa county; the wealth of minerals and the newly discovered gem-studded Colorado Desert of San Diego county, exhibit for investigation a field of geological wonders more diversified in its character than is found in any other part of our country, and probably in the known world, and nowhere has the biologist found so wonderful an assemblage of aquatic life as in the semi-tropic waters of the Pacific which lave her shores. Our equable climate affords exceptional advantages for astronomical observations, and a study of our flora has revealed curious, rare and valuable plants found in no other land, while the excavations on the Channel Islands and in the localities which were the habitat of the extinct tribes of this Coast, have revealed new and curious matter for study by the ethnologist.

All of these subjects have been discussed, accompanied by numerous and excellent illustrations, in our Bulletins, and these papers have attracted the attention of learned specialists.

JAN 29 1909

During the short period that has elapsed since the election of the present Secretary, he has had numerous requests from Libraries, Universities, Academies of Science, and other learned Bodies all over the United States, not only for specific numbers, but for complete sets of the Bulletin. He has been unable to satisfy the demand, as there are only six complete sets remaining among the property of the Academy. There are, however, ten other sets nearly complete, some of them lacking but two numbers; and in another place will be found a call for these missing publications.

A Few Words Relating to the Academy.

In 1891 it had its inception as The Southern California Science Association, which designation was changed in 1895 to the present name. The Founders were few in numbers and weak in financial resources, but enthusiastic in their determination to effect a permanent Scientific Organization. Many of the original associates in this work are today among the most active and zealous members of the Academy.

Through the long years of trials, discouragement and pecuniary difficulties they at no time lost courage, and from their own liberality they met all deficiencies in the expenses of the work. No Macedonian cry of "Come over and help us" was ever heard from them, and we, the later members, are now enjoying the results of their splendid labors, which have placed this Academy of Sciences upon an enduring basis. Surely the unselfish spirit, free-handed liberality and courageous independence of those men and women may warrant them in demanding as the motto of this Corporation, "Nostra Tuebimur Ipsi" for the future, they have so strenuously lived up to it in the past.

Holdridge Ozro Collins.

For many years it has been suspected by Astronomers that there is a planet of our system, moving in an orbit beyond that of Neptune, but there has been no Adams or Leverrier to demonstrate its position.

On the first day of this month the news was flashed around the world that Professor Pickering, Director of the Harvard Observatory, had found upon the sensitive plates an ultra Neptune planet in the Constellation Gemini, and very near the place at which Uranus was discovered by William Herschel. All Astronomers will await, with intense interest, the verification of this discovery. H. O. C.

Additions to the Southern California Flora

S. B. Parish.

Chloris elegans H.B.K. Nov. Gen. et. Sp. 1:166. Roadside at Riverside, Aug., 1904, F. M. Reed, where perhaps only a waif. Reported by Beal (N. Am. Grasses, 2:403) from "California," but without definite locality. There is a specimen in the herbarium of the University of California, collected by Mr. E. E. Sellenger, on flood lands of the Colorado river, near Palo Verde. In that region it is certainly indigenous, and probably not infrequent.

Eleusine indica Gaertn. Fruct. et Sem. 1:8. In a lawn at Los Angeles, 1907, E. Braunton. This is the first reported appearance in California of this widely distributed tropical and sub-tropical grass.

Cyperus virens Michx. Fl. 1:29. Banks of Warm Creek, south of San Bernardino, Oct., 1907, 6165 Parish. The southern known limit.

Polygonum Kelloggii Greene. Fl. Fran. 134. In wet soil, at high altitudes in the San Bernardino mountains. Bluff Lake, 7,400 feet altitude, Mrs. H. E. Benton, July, 1908. Bear Valley, 6,500 feet altitude, Aug., 1882, 1509 Parish.

Calandrinia Breweri Watson. Proc. Am. Acad. 11:124. City Creek road, San Bernardino mountains, at about 2,000 feet altitude, May, 1907, 6221 Parish. The type was collected by Brewer in the Santa Inez mountains, and the present locality is the southern limit.

Radicula obtusa Greene, Leafl. 1:113. **Nasturtium obtusum** Nutt .T & G. Fl. 1:74. Bluff Lake, Aug., 1908, Mrs. H. E. Benton. The southernmost locality reported for the west coast.

Cardamine oligosperma Nutt. T. & G. Fl. 1:85. Topango cañon, Santa Monica range, Los Angeles county., March, 1908, Dr. H. E. Hasse.

Mentha arvensis L. var **glabrata** Fernald, Gray's Man. 7th Ed. 711. Bluff Lake, San Bernardino mountains, Aug., 1908, Mrs. H. E. Benton. Not heretofore reported from the Pacific coast. The variety **canadensis** is common at lower altitudes.

Veronica arvensis L. Sp. Pl. 14. In lawns, Soldiers' Home, Los Angeles county, July, 1900, Dr. H. E. Hasse; Riverside, June, 1907, F. M. Reed.

Plantago fastigiata Morris, Bull. Torrey Club 27:116. Coachella, Colorado desert, 595 L. A. Greata. Identified by Mr. E. W. Morris. In his original description, Mr. Morris gives the habitat as "Arizona and Southern California," but cites no localities. The plant belongs to the desert flora.

Plantago virginica L. var. **longifolia** Gray, Syn. Fl. 2, pt. 1:392. Corona Bluff, Orange county, May, 1908, Dr. A. Davidson. Not before reported from California.

New Botanical Records for Los Angeles

A. Davidson, M. D.

The year 1908 has added but few new records for our county, and some of these are at present only casuals. It is always of interest to record the first appearance of what may seem but an unimportant introduction, as experience has shown that it is not always possible to foresee the ultimate result thereof.

Vaccaria Vaccaria Britton. Along a ditch on Lima street, Sierra Madre, a few plants. This is the troublesome "cockle" of the wheat fields in the Middle West, and I think this is its first reported appearance in California.

Silene noctiflora L. Lawns at Alhambra.

Madia Wrightii Gray. Half a dozen plants on Drumholly, Hollywood. Probably introduced.

Gilia ochroleuca Jones. Common in my garden for the last two seasons. For a number of years I have observed occasional plants of this species in the neighborhood of Los Angeles, but I was unable to identify them. Mr. Parish kindly named it.

Convolvulus Binghamiae Greene. Common in most grounds at Rivera; San Gabriel River; Cienega, etc., and as heretofore passed as **C. sepium** or **C. repens.**

Cakile californica Heller. Is abundant at Balboa and Corona del Mar beaches, and probably extends to our coasts adjoining.

Lotus hematus Greene. This plant, common enough in Catalina, was found for the first time in the mainland on Providentia ranch, Hollywood.

The Blue Butterflies

By J. R. Haskin.

On account of their small size but few people except collectors realize how numerous, both in species and number, are the Lycaenae, or Blues. Although so small, there is enough variation among them to justify their classification into thirty-eight species in a popular work on North American Butterflies. Another able writer actually classifies fifty species on the Pacific Coast side of the Rockies.

They are essentially a Western genus, as, although several species are common enough, there are hardly as many species in the whole country east of the Mississippi as can be taken in a day's outing in the country about Los Angeles. Within the possibilities of such a day at least a dozen species are available to the student. The illustration of Lycaena Antiacis shows a typical species of this beautiful group. A trip to the foothills and gullies, near Newhall for example, in April or May, can hardly fail to bring in a choice set of them.

Lycaena Antiacis
The Eyed Blue

The One Hundred Inch Reflector on Mount Wilson, California

By Holdridge Ozro Collins, LL. D.

It is a subject for comment that the largest telescopes throughout the world have been constructed by the liberality of individuals, and perhaps a majority of the greatest discoveries, as well in Astronomy as in the other Sciences, have been made by those, working in a private capacity, with their own instruments and in their own observatories, and having no connection with any public institution.

From Galileo's small objective, with a magnifying power of only 33 diameters, which in January, 1610, first presented to an amazed world the four moons of Jupiter, the list down to the present is a long one, embracing the 48 inch Reflector of Herschel in 1789; the six foot Reflector of Lord Rosse in 1845; the five foot Reflector of Dr. Ainslie A. Common in 1889; the Lick Equatorial of 36 inches; the Yerkes Equatorial of 40 inches; the 60 inch Reflector just completed, and the Snow horizontal Reflector of 24 inches, both on Mt. Wilson, and an innumerable number of powerful instruments with objectives from 12 to 28 inches in diameter, all of which have been constructed and operated without government aid.

The creation of a perfect achromatic Refractor is much more difficult than that of a Reflector of the same aperture, and it is thought that the limit has been reached in the size of the Refractor objective, owing to the elliptical image resultant from the flexure of a large suspended object glass. The objective of the Refractor constructed for the Paris Exposition of 1900, is 50 inches in diameter, but it was found impossible to mount it as an Equatorial, and it was placed horizontally upon piers, objects being reflected into it by mirrors.

For the Reflector, however, the spuculum which will give a perfect and sharp definition, can be made much larger than is possible for a practicable Refractor objective of a corresponding size.

Between the years 1660 and 1670, Sir Isaac Newton and James Gregory, working independently, discovered the advantages of the Reflector.

In the youth of the Reflector, the speculum was made of various alloys of silver, nickel, zinc and arsenic, and later, almost universally of copper and tin, with perhaps a small amount of arsenic to increase the whiteness. This form is

found at the present time to some extent, but silvered glass has proved itself superior in many respects, and it is being now generally used.

A few years ago the Carnegie Institution of Washington decided to erect a 60 inch Reflector, for a Solar Observatory, and after a careful examination of many localities, Mount Wilson was selected. Its summit being nearly 6000 feet (5886), above the ocean; located but a short distance from Los Angeles, the Metropolitan City of Southern California; in a district exempt from tornadoes, cyclones and hurricanes: above the fogs; with an equable climate and an atmosphere phenomenally free from disturbances, it offered advantages not equaled by any other known place; and here has just been completed the erection of the 60 inch Reflector.

During the last decade of the marvelous growth of Los Angeles, one of her most energetic, public-spirited and prosperous citizens has been John Daggett Hooker. A man of unassuming personality, identified with all good works for the advancement of the material interests of Southern California, and, from a modest beginning achieving a distinguished position in the mercantile world, he has been a leader among those working for the higher intellectual advancement in our midst, more particularly in the way of affording facilities for scientific pursuits. In early youth he became interested in Astronomy, and this interest has been maintained by study and observation down to the present time during a life of close application to avocations which, to most persons, would have proved an element of distraction. Several years ago he purchased a Byrne five inch objective, and, fitting out the entire upper story of his spacious Colonial residence on Adams street as an Observatory and work room, he not only entered upon a systematic observation of the outer worlds, but he placed all his instruments and his residence and grounds at the unrestricted use and occupation of the Astronomical Section of the Southern California Academy of Sciences, of which he has been a member almost since its inception.

Mr. Hooker had become profoundly impressed by the work with the Crossly Reflector on Mt. Hamilton and with other Reflectors which had disclosed the wonders of Nebulae never seen by the eye, and beyond the powers of definition by the largest Refractors, except upon the sensitive plate after long exposure, when used for photographing.

If a sixty-inch Reflector will accomplish more than has been done by the Crossly, what will a hundred inch speculum disclose? The construction of such an instrument would be the work of comparatively a short time, and a vigorous constitution and years but little past the middle age gave promise

that he might live to explore through a telescope of this magnitude, the realms far beyond what we now call outer space. Enthused by this thought, he entered into communication with the Carnegie Institution at Washington, and offered to give the sum of Fifty thousand Dollars for the manufacture of a Reflector of this size. The proposition was accepted and there was no delay in prosecuting the work. The order for the casting of the glass disk was given in September, 1906, to the French Plate Glass Companies at St. Gobain, France, and during the year between the Spring of 1907 and June, 1908, six or eight castings were made.

In order that there might be no delay in grinding polishing and figuring the disk after its arrival, Mr. Hooker constructed at Pasadena, in the Winter of 1907, a building which he supplied with all necessary appliances. The main room is 34 feet square and 20 feet high, and opens into a long testing hall.

"The walls of this room are very heavy, made of brick laid in cement, and covered with a roof of reinforced concrete. This portion of the building, which is separated from the other part by iron doors, may therefore be regarded as fire and earthquake proof—a consideration of no small importance, in view of the nature of the work to be done within it. A heavy steel I-beam, supported over the doorway, carries a traveling crane, by means of which the mirror-disk and heavy parts of the grinding-machine, one of which weighs 3.5 tons, can be brought into the room and handled when necessary during the progress of the work. The testing-hall, 100 feet long and 10 feet wide, will permit the mirror to be tested from the center of curvature or with parallel light. . . . On one side of the testing-hall are rooms for the grinding and polishing tools and for the apparatus required to maintain the polishing room at a uniform temperature. There is also a large fireproof vault, for the storage of astronomical photographs. On the other side of the hall a series of computing offices is provided, affording, with the rooms already available in the adjoining building, suitable accommodations for a large staff of computers."*

In June, 1908, information was received at Los Angeles from the Glass Companies at St. Gobain that the casting of a perfect disk 102 inches in diameter, 13¼ inches thick and weighing 4½ tons, had been successfully accomplished. On December second, 1908, in its iron case, it reached the end of its long journey and it was deposited in the Hooker building at Pasadena, but upon being unpacked it was immediately seen

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*Annual Report, 1907, of Prof. George E. Hale, Director of the Mount Wilson Solar Observatory of the Carnegie Institution of Washington.

that the lens was imperfect and did not fulfill the conditions of the order. Mr. G. W. Ritchey has been instructed to proceed at once to France and secure the casting of a perfect disk at the earliest time possible. It is hoped that this will be accomplished in a few months so that the grinding and polishing may be commenced by Spring.

This work and the five small accessory mirrors with the manufacture of the driving clock and the designs for the mounting, the steel dome and the building will be done by Mr. Ritchey and will require about three years. The cost of the optical parts will consume Mr. Hooker's Fifty thousand Dollars and it is estimated that the expense of the mounting, dome and building will amount to several hundred thousands of dollars.

Telescopes serve the Astronomer in a two-fold manner: First by their mighty power for gathering light. The unaided eye receives from an object as many rays as fall upon the pupil, which, under normal conditions, is about one-fifth of an inch in diameter. The object glass of a telescope serves as a pupil of larger dimension, and as many rays as fall upon it are carried to the retina of the eye. The increase in light-gathering capacity is in the ratio of the square of the diameter of the object glass to the square of the diameter of the pupil of the eye, and with an hundred-inch speculum, stars which are beyond the vision, not only of the naked eye, but even imperceptible through powerful telescopes, would become visible.

The second function of a telescope is to magnify the image at the focus. Galileo's telescope brought Jupiter's satellites 33 times nearer to his vision. It is difficult to state what magnifying power an hundred-inch mirror will allow, so much depends upon the "seeing" in using light-gatherers of large dimensions. A conservative estimate would probably be from fifteen hundred to two thousand diameters.

Wanted

Any numbers of Volumes III, IV, V, and VI of the Bulletin, particularly Numbers 4, 6 and 8 of Volume III, Number 5 of Volume IV, and the Index of Volume V.

We shall be greatly obliged to members who will send to the Secretary any of these numbers, as they will enable him to complete sets which are in demand.

The whole of Volumes I or II will be cheerfully exchanged for No. 6 of Volume III, or No. 5 of Volume IV. Send them to the office of the Secretary, 625 San Fernando Building.

Observations on the Teeth of Pueblo and Cliff Dwellers

By Dr. F. M. Palmer.

During the seasons. 1905-6. it was my privilege to make an examination and exploration of certain pre-historic ruins characteristic of the great plateau country lying in the southwestern part of the United States.

As a result of these researches, observations were made and opinions tentatively formed, that may, possibly, be held of value as supplemental to what has previously been recorded.

An investigator in this field is at once impressed by certain features characterizing the skeletal remains of its ancient inhabitants.

His attention is first arrested by noting a pronounced abnormality, in form, of the crania—a malformation produced by an artificial flattening of the occiput. The prevalence of marked lesions, and irregularity in arrangement of the teeth, also differentiate the remains of these people from similar remains of other races by whom they were surrounded.

The condition of these organs challenge attention, and invite investigation as to probable cause.

I propose to briefly discuss these conditions. Before doing so, however, I invite your attention, for a moment, to a consideration of the topographical features of the country in which these explorations were made, and to the civilization evolved by the ancient Pueblo and Cliff dwellers.

The bibliography treating of these subjects has dealt with them so exhaustively that an epitomized statement will answer the purpose of this discussion.

A territory of more than 150,000 square miles constitutes the area of occupancy by the people we are considering. It is very largely of forbidding aspect, except to those who love nature best when face to face with its wildest presentation.

The most conspicuous features of the landscape are rugged and blackened mountain ranges, measureless stretches of blistering yellow sand, barren mesas, appalling chasms, and stupendous cliffs of fantastically colored sandstone.

Devastating winds, torrential rains and cloudbursts, seismic shocks and volcanic eruptions, have here wrought upon the earth's crust an imperishable record of their power.

The forestation of its mountains, a sheltered nook here and there in its cañons, an occasional valley redeemed by the vivifying influence of spring, or mountain stream, is all that

does, or ever did, make this country possible as a home for man.

Here, however, was evolved a culture which manifested itself architecturally in many-storied buildings, constructed of rudely squared blocks of stone, laid in mortar composed of sand and clay.

Frequently these buildings—outside and in—were plastered. Interiors were often, and exteriors sometimes, given a coat of whitewash over the plastering.

It was here that—within the limits of the United States—fictile and textile art were brought into their highest expression by primitive man.

Culinary operations were conducted within the buildings, in rooms set apart for that purpose.

Fireplaces made of squared slabs of stone were built against the wall, or in the corner of a room. In some of the larger and better constructed buildings, however, I found in the center of the rooms what were, practically, box-stoves, or ranges. Three slabs of sandstone were wrought to equal dimensions, about 6 dm. in length and 4 dm. in width. One of these slabs was laid upon the stone floor in the center of the room, the remaining two were placed on edge by its sides, a shorter slab, but equal in height to the sides, was placed across one end, the other end being left open. These slabs were securely held in proper position by clay that, while moist, was plastered over and banked up around them on the outside.

The top was made of a slab somewhat shorter than the sides. A circular hole, 15 to 18 cm. in diameter, was wrought in the center of the slab. This hole, over which a cooking pot was placed during culinary operations, facilitated the cooking of its contents, exactly as do the holes in the top of a modern range.

A proper draft was secured by the front of the stove being left open, while the removable top could be pushed forward or back, as was required for leaving a suitable opening for the escape of smoke.

That, however, which primarily distinguishes the culture of these people is the skillful engineering displayed in establishing grades and levels for canals, ditches, and reservoirs, made necessary by their system of irrigating land for agricultural purposes.

I have personal knowledge that, in many instances, the grades and levels of these ancient canals have been—without alteration—incorporated in plans of modern engineers.

Investigation has disclosed that these people were possessed of a sufficient supply of suitable foodstuffs. Cultivation of the soil gave them corn, squashes, pumpkins and beans in abundance. They had domesticated the wild turkey, and possibly deer and rabbits.

Their cooked meats and vegetables were made palatable by a seasoning of salt.

They were abundantly supplied with fruits, berries and nuts, indigenous to this region.

A sufficiency of water was easily obtained.

Their lives were passed in an atmosphere invigorating and free from taint.

And, finally, their environment and culture were such as made necessary a reasonable amount of physical exercise.

I have dwelt on this phase of my subject at some length, as I desire to show that these people were possessed of all essential factors for producing a physically perfect race of men.

I now ask your consideration of the teeth of an adult Pueblo dweller.

With exception of the superior left lateral incisor, all the permanent teeth are present.

Referring to the superior maxillary, there is noted a space five mm. in width between the right lateral incisor and the first bi-cuspid. The cuspid which should occupy this space, has been crowded out of the arch, and is seen with its lingual surface resting equally upon the buccal surfaces of the bi-cuspids.

The permanence of this space, and the abnormal position of the cuspid, is doubtless due to the elimination of the temporary cuspid having been retarded until after all the permanent teeth were fully erupted.

The position in the arch that should be occupied by the missing left lateral incisor is filled by the first bi-cuspid, while the normal position of the bi-cuspid is occupied by the cuspid.

There is nothing to indicate that the missing lateral was ever erupted. Neither is it present in any part of the maxillary bone.

It is stated in Harris' "Principles and Practice of Dentistry" that transposition of tooth germs sometimes occurs. Cases are cited in which the germs of lateral and central incisors were transposed. Other cases involve the lateral incisors and the cuspids. I have, however, been unable to find any record of transposition of germs of the cuspid and bi-cuspid, as is seen in this case.

Non-development of teeth is not of such rare occurrence as to be of special interest. Investigation will usually disclose the abnormality to have been hereditarily transmitted.

In the authority previously quoted, Dr. George Watt, an eminent American dentist, states that he had knowledge of "a family in which its female members for four generations lacked the left superior lateral incisor."

Skull of Cliff Dweller. Cañon De Chelly, Arizona Territory.

The molar teeth of the inferior maxillary present extensive lesions resulting from caries.

The major portion of the grinding, and distal surfaces of the left third molar, are affected.

Destruction of tooth substance is more pronounced in the left second molar. The entire grinding, and greater part of the mesial, distal and buccal surfaces are involved. A large opening into the pulp chamber establishes exposure and devitalization of the pulp.

The crown of the first right molar is entirely destroyed. Exposure, devitalization and suppuration of the pulp necessarily followed.

The necrosed roots still remaining in their sockets, and visible through openings (resulting from absorption) in the plates of the process, tell the story of alveolar abscess, and supply the climax in the destruction of this organ.

The conditions presented by the teeth under consideration are undoubtedly due to the same causes that are impairing the usefulness and durability of the teeth of the most advanced races of today. Briefly stated, these causes are a lack of thorough mastication of food, and the baneful influence of transmission of physical deterioration by heredity.

As I have previously stated, the Pueblo and Cliff dwellers possessed a varied and abundant food supply.

The number of clay cooking-pots, cracked, warped and blackened by smoke, which have been taken from their houses and cemeteries, and the rarity of baking-stones, makes it clear that it was their custom to boil rather than to roast or bake their food.

It may, I believe, be safely assumed that the greater part of their diet consisted of corn, squash, beans and possibly other vegetables that (while green) were cooked by being boiled.

The corn after maturing was ground into meal, when, as evidenced by remains in some of the cooking-pots, it was made into mush or porridge.

Stews consisting of meat and vegetables were, no doubt, prepared in the same manner.

It is clear that food prepared as is here indicated would probably receive but little mastication. Deterioration of the teeth would necessarily ensue.

In support of this conclusion, I quote from a work entitled, "The Cause and Prevention of Decay in Teeth," by Dr. J. Sim Wallace, a distinguished dental surgeon of England, and will add that, as a result of my own observations during thirty-six years devoted to the practice of dentistry, I unqualifiedly endorse the statements of Dr. Wallace. Furthermore, I believe that similar views are held by a majority of advanced members of the dental profession. Dr. Wallace writes:

"In the early periods of man's existence there was little social cohesion, and each individual had, to a great extent, to concern himself with securing food, and, when he had the opportunity or inclination, with cooking it.

"When we compare such a state of affairs with the various methods of securing food at the present day, and the elaborate machinery (flour mills, rice mills, sausage mills, sugar refineries, meat juice factories, etc.,) by which many of the foods are refined, not to speak of the processes to which foods are sub-

jected in our bakehouses, biscuit factories and kitchens, we see that there is some difference in the food of the present day from that in past ages. It may be said, however, that after all the foodstuffs have not essentially altered. We require proteids, carbo-hydrates, fats, water and mineral matter much in the same proportion as our ancestors, and this is what we get.

"There is one change, however, which has gone on, and is at the present time going on, till it has reached a stage which is absolutely detrimental to the well-being of the teeth, stomach, alimentary tract and body generally. There is a gradual elimination of all the coarse, fibrous, inert and undissolved earthy matters which are present, more or less, in the food of savages. The muscles of the jaw are not generally used as much today as when food was more difficult to get, and so the nerves of the teeth and the entire bony structure are not usually as well nourished as formerly.

"Another effect produced by the elimination of the coarse and fibrous parts of many foodstuffs is to encourage the habit of swallowing the food without much mastication.

"There are, I believe, many people who are so accustomed to eating food that requires little chewing that they often swallow food unchewed, which otherwise would be subjected to a certain amount of mastication. Of course, in such cases decay of the teeth is liable to be more frequent."

This statement is of importance to this discussion, as, when followed to its logical conclusion, it appears to demonstrate that the teeth of man are adversely affected by the refinements of civilization. Furthermore, it may safely be assumed that defective organization, impairment of function, and premature loss of these organs, would keep exact pace with cultural advancement from a state of nature (savagery) to one of advanced civilization. And this is exactly true of races inhabiting the earth today.

The influence of heredity in transmitting physical characteristics is also to be considered. Persistence in transmission is conclusive evidence that, for a long period of time, successive generations had existed in an unchanged cultural environment.

If these conclusions are correct, it follows that the teeth constitute an index by which the degree and duration of the civilization of pre-historic races may be comparatively measured.

Our Food Fishes

By Prof. J. Z. Gilbert.

The Flounder Family.

"Flat as a flounder" expresses the distinctive character of this family of fishes. The adults are colored on one side, and plain on the other. They swim upon the plain side and both eyes are upon the colored one. The young, though flat, have both sides alike, and swim upright in the water, and have one eye on each side of the head. This last feature changes during growth by the one eye of one side moving around with the twisting of the skull or through to the other side. All have teeth.

There are three tribes of this family, the Halibuts, the Flounders, and the Turbots. In the first two the ventral fins are symmetrical and alike, while in the last they are unsymmetrical, and the one on the one-eyed side extends along the ridge of the abdomen. The Halibuts are recognized by their mouth, it being symmetrically developed and having teeth on both sides, while the Flounders have an unsymmetrical mouth and the teeth are chiefly upon the blind side, while the eyes and color are upon the right, thus "right handed." The Turbots have the eyes and color upon the left, hence "left handed." In the Halibuts these may occur upon either side.

The most valuable of these for food are: Common Halibut, Hippoglossus-hippoglossus, Linn; Jordan "Sole" Flounder, Eopsetta jordani; Pacific "Sole," Psettichthys melanostictus; Monterey or Bastard Halibut, Paralichthys californicus; Great or Starry Flounder, Platichthys stellatus.

The Common Halibut.

This very common fish is found not only in our waters from San Francisco north, but is found also on both sides of the Atlantic from about 40 north to Iceland and Greenland, as well as north of the English channel.

It attains a great size, equaling that of the tuna, and single individuals weighing over 700 pounds have been taken. The average fish marketed seldom exceeds six or eight pounds.

The temperature enjoyed best is a very cold one, being even as low as freezing, hence these fishes are taken in northern waters or at the greater depths, where they are often associated with the Cod.

This family are quite voracious eaters, gathering as they go their regular meal of crabs, mollusks and fish, and often scraps of debris, pieces of wood, iron, pebbles, lost jewelry, etc. They kill their prey by striking it with their powerful

tails, or by crushing it between their strong jaws. They themselves become a delicate meal for seals, whales and sharks.

The flesh of the ordinary size is generally firm, white, and of a delicate flavor, the female being preferred, while that of the larger ones is dry, coarse and unsavory.

The supply from the Pacific is enormous, which is said in the late years to exceed seven million pounds, with a value of over two hundred thousand dollars.

The time of spawning varies with species, this one spawning in the spring months. The supply of eggs is enormous; one species of the Atlantic weighing 200 pounds, produced over 2,000,000 eggs.

The Jordan "Sole" Flounder.

This member of the halibut tribe is a favorite of the Chinamen, who dry them in great numbers, suspending them by strings fastened to frames placed on the roofs of their houses. There they may be seen dangling and flapping in the breeze.

This is one of the finest food fishes of the group, and reaches an average weight of three or four pounds.

The dorsal fin has fewer than 95 rays, and the anal fewer than 75.

The lateral line has no anterior arch, and a double row of teeth occurs in the upper jaw; adherent scales in the lateral line, 96.

"The Pacific "Sole," "Local Sole," "Deep Sea Sole."

Plate I, Figure 2.

This very common flounder occurs from the Monterey Bay to Sitka.

It weighs on an average about three pounds. It is always

found in the markets, and is regarded as a fine food fish. This species may be distinguished from the last by its single row of teeth in the upper jaw, and the lateral line having an accessory dorsal branch.

The Monterey or Bastard Halibut.

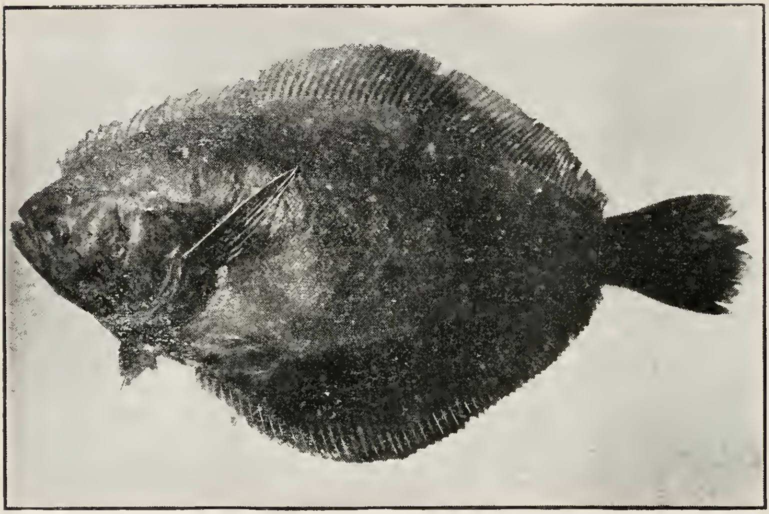


Plate I, Figure 1.

This is a very large species, attaining a length of four feet and a weight of 60 to 70 pounds. Although the flesh of the larger ones is coarse and tough and that of the younger ones is inferior to that of the Pacific sole, yet this fish abounds in the markets because of its beautiful flesh and fine "cuts," and at the same time answers very well the general demand for quality.

This fish differs from the Pacific sole in having a lateral line with an anterior arch.

The Starry Flounder.

This true flounder is "left handed," that is, it has the color and eyes upon the left side, instead of on the right, as is usual with the flounders. It is readily recognized by its bands of black in the fins, the regularly banded margins and wavy lateral line, and the general surface irregularly but thickly spangled with starry spots or tubercles among which darkened blotches more or less faintly appear. This fish amid the tints and shadows of the sea is not readily recognized, but when viewed in proper lights and at right angles it becomes a thing of charming beauty.

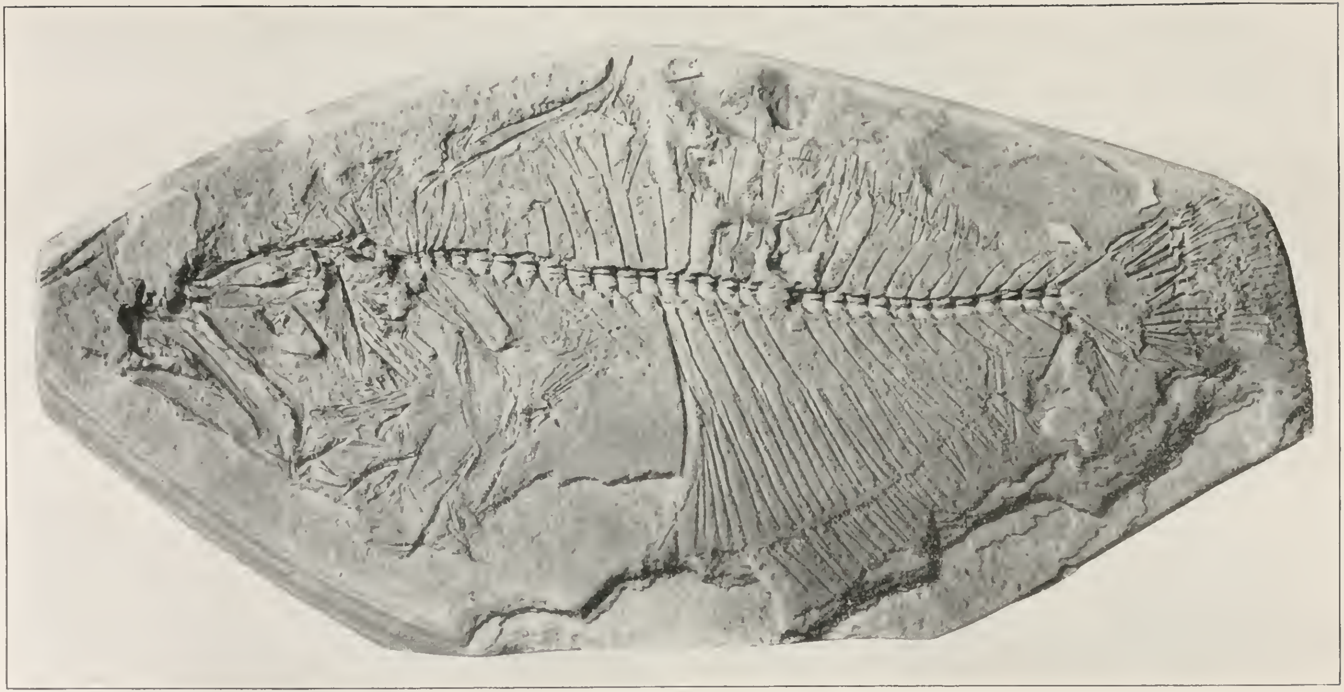


PLATE II.

Fossil Flounder imprint found by workmen of the Magne-Silica Co., Los Angeles, near Lompoc, in the Miocene formation.

It is a most excellent food fish, the flesh being tender, savory and delicious. It occurs in abundance from San Francisco north, and along the Asiatic coast. Being a shallow water fish, it often appears in the estuaries and in the rivers.

It is not a large fish, its average weight being about 10 to 12 pounds, yet it furnishes about fifty per cent. of the total flounders taken.

The flounders are said to be quite gamy, affording no little sport in the landing of the larger specimens. Their bite is the slightest nibbles, then a start, a rush, a darting to and fro, then heavy surging in its efforts to escape characterize the conduct of the "sockdolliger" of the Atlantic.

A Fossil Flounder.

Preliminary Notes. Part I. To be named in my next paper.

Fossil specimens of the flounder are very rare, and to find one such as is figured here is a very pleasant surprise. This specimen was found near Lompoc, Santa Barbara county, in the diatomacious earth of the Miocene formation.*

This was a fish greatly compressed, having eyes and color upon the right side, the dorsal fin continuing from in front of the eyes to near the caudal, and a corresponding ventral fin. Only an imprint of the fish remained to tell its story.

This interesting specimen presents quite a number of features which place it as an earlier branch of the tree of animal development than that of the halibuts and flounders. Indeed, there are strong suggestions that this is a generalized type from which these two have sprung and thus forms a connecting link between them and lower forms.

If Miocene formation is the proper designation for the diatomaceous rocks in which this fish was found, then while the shales upon which much of Los Angeles rests were forming in the sea, the fishes of this type, the best flounders to this time, were swimming over the diatomaceous beds forming in the sea over Santa Barbara county. The undisturbed condition of the skeleton, and the total removal of osseous substance leaving a hollow cast in the ooze, suggest a deep-sea fish, or that the fish suddenly dropping to the bottom was buried in the ooze and gradually destroyed by the living forms whose skeletons, in turn, made the casket of our fossil.

*Fossil by the kindness of the Magne-Silica Co.

Startling Phases of a Great Comet

By Wm. H. Knight.

The great Comet Morehouse (1908 c), which arrived at perihelion on Christmas day, 1908, is, in the language of Astronomer Barnard of the Yerkes Observatory, "the most bizarre comet that we have had to deal with since photography began to register the freaks of the tails of comets. Almost nightly it has shown features that would have singled it out as a very remarkable object, and on more than one occasion it has presented a most extraordinary and unique appearance."

It is now swinging round the sun in a great parabolic curve, having arrived from mid-heaven above the plane of the earth's orbit, and plunged through that plane to the mid-heaven below, at an angle of 140 degrees; consequently its motion round the sun is retrograde, or contrary to that of the earth.

At its perihelion passage (point nearest to the sun) on the 25th of December, the comet was barely 5,000,000 miles within the earth's orbit, as shown in the accompanying diagram, but the earth on that date was at the opposite extremity of its orbit, or about 180,000,000 miles distant from the comet.

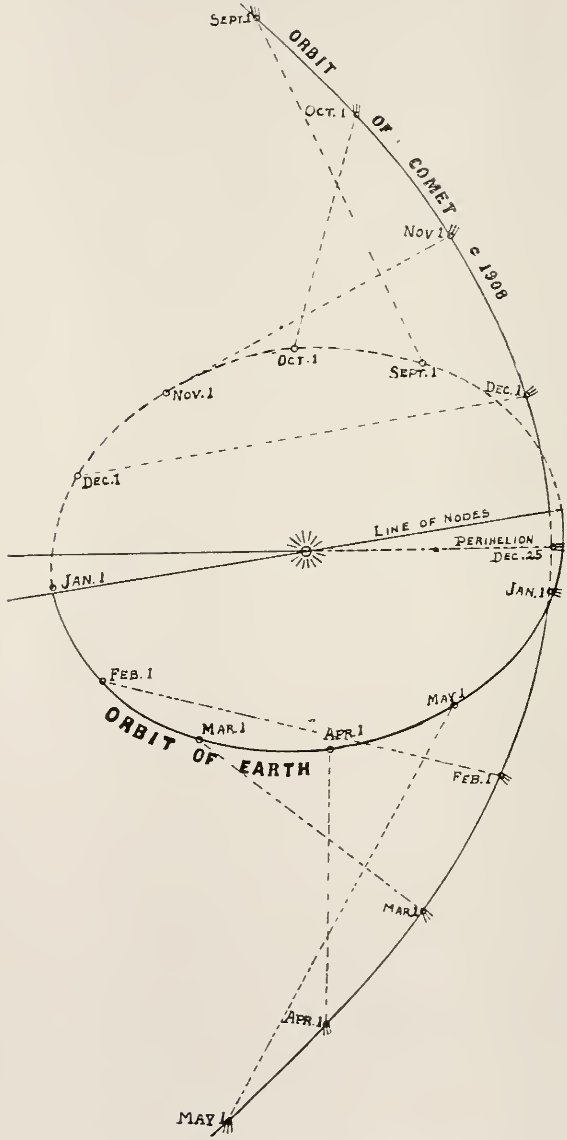
Suppose the great comet had arrived at the same point six months earlier, we should then have beheld this enormous but loosely aggregated mass of matter, partly self-luminous, and having a diameter about one-third that of the sun, at such close range that we could readily observe the violent disturbances going on within its brilliant nucleus, and it would have formed an important epoch in astronomical research.

Its mysterious tail, an appendage streaming out into space for a distance of 27,000,060 miles, would have completely enveloped the earth, and would possibly have introduced some noxious elements into our atmosphere, though under such extreme dilution as to be quite harmless. It is asserted that the earth plunged through the tail of a great comet which suddenly flamed across the northern sky in 1861, and that the only noticeable effect was a slightly roseate hue in the atmosphere.

When the Morehouse comet was first seen by its discoverer, September 1, 1908, it was 140,000,000 miles away, but while it was approaching, the earth was moving in an opposite direction, and during the month of October the two bodies were but little more than 100,000,000 miles apart. On account, however, of the high declination of the comet, within thirty degrees of the celestial north pole, it could be observed from sunset to sunrise.

These opportunities were so well availed of in some

observatories that many photographs of this object were taken by different observers during the same night. Prof. Barnard made no less than 239 photographs on forty-seven nights, thus enabling him to note the changes in the form and brightness of the tail, not only from night to night, but also from hour to hour, and many of these were surprising.



Orbit of the Morehouse Comet (1908 c.)
(Diagram reproduced from "Popular Astronomy.")

Before proceeding to narrate some of the marvelous transformations which his sensitive films recorded, it may be well to state certain theories now held regarding the formation of a comet's tail. The researches of Arrhenius and the experiments of Nichols show that the repulsive force which drives the exceedingly minute particles from the comet is due to the pressure of light—the impact of the sun's rays. These infinitesimal particles, though so numerous as to form a gossamer trail of light behind the comet, are yet of such extreme tenuity that faint stars can be seen through clouds of them which are thousands of miles in thickness. But these trails of light are subject to remarkable distortions, deflections and curvatures in form, and also to sudden and frequent changes in brilliancy, probably due to other causes than light pressure, perhaps electrical.

As an example of the capricious behavior of the Morehouse comet, on the 14th and 15th of October it was faintly visible to the naked eye; on the 17th it was not thus visible; but in the latter part of the month it grew so bright that on the 29th it was pronounced very conspicuous, with a tail which could be traced for five or six degrees. On the very next night, October 30th, it was comparatively faint.

On the 14th of October, Mr. Miller at Swarthmore, making telescopic observations, noticed two condensations or luminous masses in the tail. On the following night he found that they had been moving rapidly from the comet's head. In the course of two and a half hours one of these condensations moved 224,000 miles, and the other 247,000 miles. A comparison of positions for twenty-four hours showed that their average velocity was 129,000 and 142,000 miles per hour, respectively.

On the 30th of September, while Director Wilson of the Goodsell Observatory was photographing the comet, its tail, then telescopically eight degrees in length, apparently detached itself from the head. On the next night the bright portion of the tail was two degrees from the comet's head, showing a rapid movement of the luminous mass during the previous twenty-four hours.

Another account mentions a similar occurrence, a narrow streamer ran out from directly behind the nucleus, and this was barely visible in the telescope, but about 45 minutes (three-fourths of a degree) from the head, the tail suddenly brightened and broadened out to a width of 20 minutes, and from this point broadened out still more and curved to the rearward of the comet's motion. These rapid transformations of the tail have not been paralleled in comet observations hitherto. They form interesting studies which are calculated to throw much light on the nature and constitution of these strange heavenly bodies.

Regarding the spectroscopic investigations of the Morehouse comet, a singular fact has been brought out. Pluvenal of the Juvisy Observatory finds that the spectrum displays the absence of the hydrocarbons, which were a feature of Daniel's comet, that attracted so much attention in 1907, whilst the complete system of cyanogen spectrum is represented. Probably this significant fact accounts for Barnard's observation that while the light of the Morehouse comet is fainter than that of Daniel's, its photographing power is much stronger.

After passing around the sun, Comet Morehouse will be seen only in the southern hemisphere, where it will be a telescopic object for several months. The astronomers in that part of the world are eagerly awaiting its appearance. The latest computed elements of the comet are as follows:

Perihelion passage, December 25.8, 1908.

Inclination of orbit, 140 deg. 10 min.

Distance from sun, 0.94554.

The perihelion distance is accordingly about 88,000,000 miles.

The comet is now moving rapidly away from the sun, but will be followed by the telescope for several months. As the congealed gases which have been fused and awakened into activity by the sun's heat become again frozen by the zero cold of interstellar space, the luminous appendage will continually grow shorter and fainter till it entirely disappears, and nothing will be visible but the faint, nebulous disk of the comet's head, till the retreating comet is lost even to telescopic sight.

We have referred to the orbit as parabolic. If it is such it will pass beyond the control of our sun's attraction, and after the lapse of some millions of years enter the sphere of influence of some other stellar body, and after further untold ages will flash its weird lights through the skies of some other circling planet, and give rise to speculations regarding its past history and journeyings through the infinite void.

On the other hand, further and more precise data may show that its orbit is elliptical, in which event, after traversing a path which will carry it thousands of millions of miles beyond the orbit of Neptune, it will move very slowly around its aphelion curve, and then be drawn again toward the sun. After the lapse of untold ages, perhaps many, many thousands of years, it will again revisit our midnight skies and repeat the phenomenal transformations of nucleus, coma and tail which have recently excited so much interest among astronomers and laymen. With what order of intelligence and with what kind of instruments will it then be observed by the denizens of earth?

The Astronomical Observatory at Vienna, Austria

By Holdridge Ozro Collins, LL. D.

The largest Building of the Vienna University, containing the Library, Lecture-rooms, Exhibition-halls, Administration-offices and Promenade-Colonnades at the junction of University street, Franzensring and Schottenring.

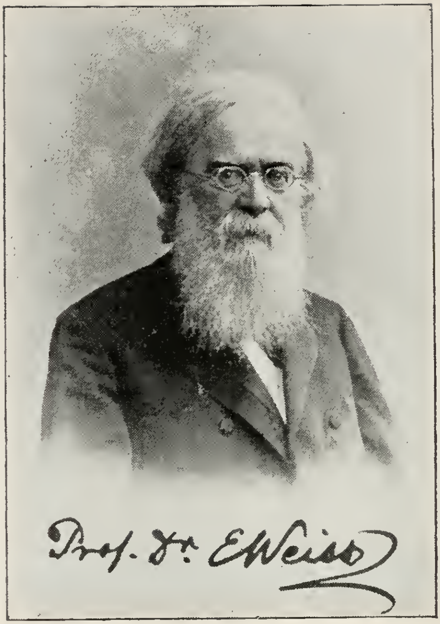
It has been my happy fortune to pass the winter of 1907-1908 in Vienna, and the most pleasant of the many agreeable events of my experience in that lively city were my reception by Professor Weiss and the facilities afforded by him for inspecting the great Observatory, of which he is Director, and an examination of the work carried on under his control.

My only credential was my Certificate of Fellowship in The Southern California Academy of Sciences, but it proved an open sesame to a most cordial and more than friendly reception.

Edmund Weiss is a Doctor and Professor of the Vienna University, and he has also the high dignity of Hofrat, or Imperial Counsellor, an honor conferred only by the Emperor, who has for him the greatest esteem, and he had the most friendly relations with the late Empress Elizabeth.

He is a gentleman of medium stature, with brilliant black eyes and a snowy mane and beard of Jovian proportions; and although seventy years old, he has the vigor and vivacity of a man of fifty.

In the several interviews I have had with him, I have appreciated his cordiality and his evident desire that I should



dispossess myself of any thought that I was trespassing upon his time or good nature.

He was much interested in what I told him of the observatories now erected and in process of construction upon Mts. Wilson and Lowe, near Los Angeles, California, and he expressed the warmest admiration for the generous gift of Mr. John D. Hooker, with a sigh of regret that Vienna had no such public-spirited citizen to present and endow a similar Reflector in this place.

He is familiar with the work of Pickering, Lowell, Campbell, Perrine, Holden, Burnham, Hall, and others of our Astronomers, some of whom he has met.

In 1872 he was sent to America to examine the large instruments there in operation, and to investigate the conditions of our work and our rapid progress in Astronomy, which were attracting much attention in Europe.

He passed considerable time at the Harvard University Observatory, and the result of his investigations was the adoption by the Austrian Government of his recommendations; and the present noble Observatory in Vienna was commenced upon plans under his suggestions, while Karl von Littrow, his predecessor, was director. Soon after its completion, an objective of 11 3-4 inches with 17 feet focal length, made by Alvan Clark

of Cambridge, was placed upon its lofty pier in the West Dome.

His staff consists of three observers or adjuncts, and two assistants, young men who have adopted the science as their life-work, and who stand in line for promotion.

The Professor commenced his career in 1858 as assistant. In 1862 he became an observer or adjunct, and in 1877, upon the death of Karl von Littrow, he was appointed Director.

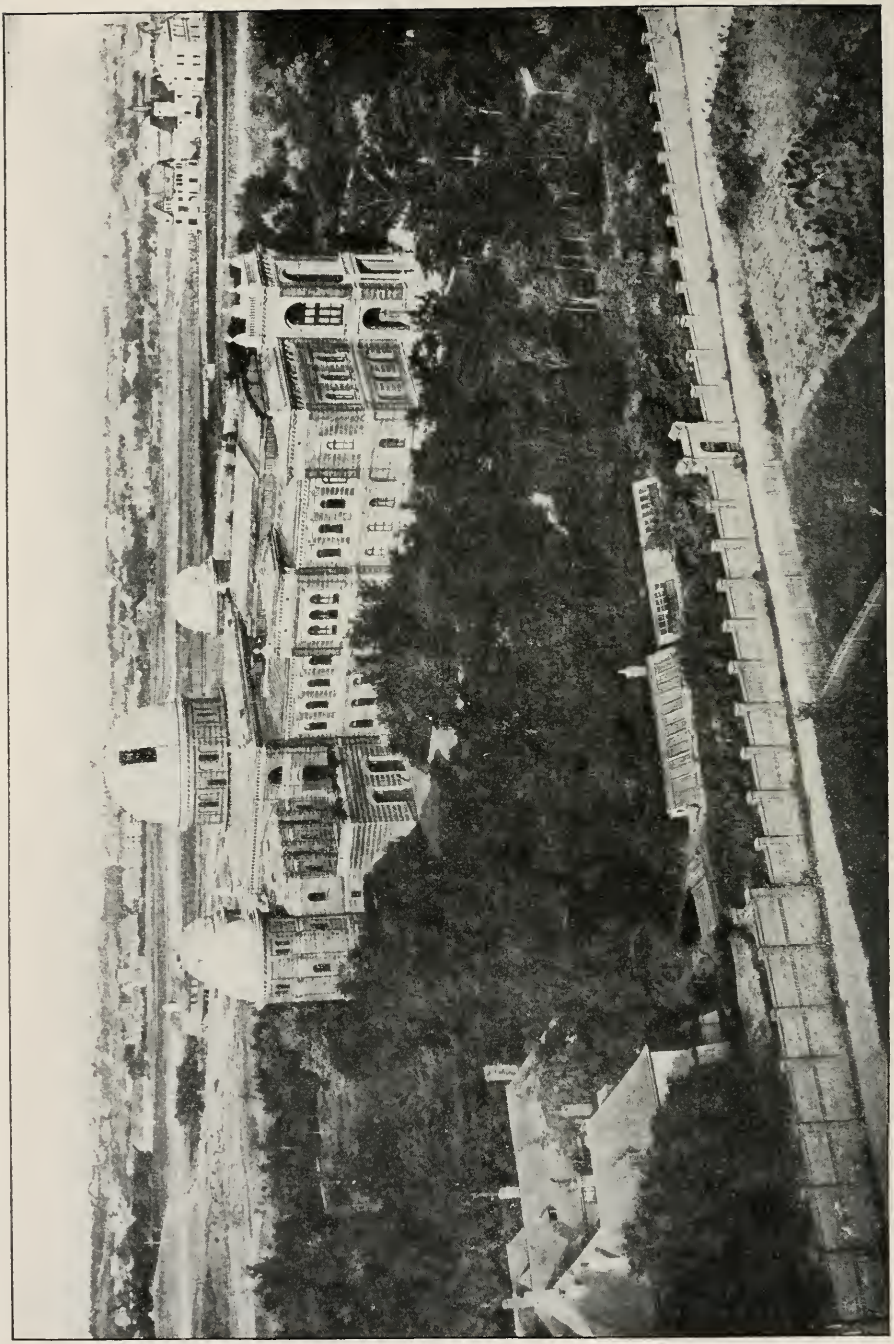
In 1756 the Vienna University had acquired renown throughout Europe by reason of its advanced educational facilities, particularly in the sciences. At this time Father Maximilian Hell, a Jesuit, was Professor of the Astronomical Section, the first to hold that rank, and the reputation he acquired by his lectures and observations induced the King of Denmark in 1769 to send him to the North Cape for the observation of the transit of Venus. He commenced the publication of the "Ephemerides Astronomicae ad Meridianum Vindobonensem" (Astronomical Memoranda at the Vienna Meridan), with a Nautical Almanac and observations of other astronomers. This publication was continued during the period from 1757 to 1786. In 1819 Joseph John Littrow, the Director, instituted the Annalen, which is practically a continuation of the Ephemerides, and this publication has been continued by his son and successor, Karl von Littrow (who was ennobled), and Professor Weiss down to the present time.

The original home of the Observatory was in the old University Building at University Place in the very heart of the city, a spacious and beautifully decorated structure, erected by Maria Theresia, where it remained until 1880.

In the great uprising of the people of Vienna in 1848, against the repressions of the Church, the brutal conduct of the police and the censorship over almost every act of the citizens, under the tyranny of the Metternich administration, the students of the University were the leaders and prominent factors.

After the capture of the city by the Imperial forces, as a punishment for their course, the students were driven from their building, and it was turned over to the army authorities for barracks. It was used for this purpose until 1857, when the soldiers were sent to other quarters and the home of the University was given to the Academy of Sciences.

During this period, while the various departments of the University were dispersed around the city, carrying on their work in such quarters as could be obtained, the Observatory was allowed to remain in its old quarters, although the work by its Professors and students was hampered by the most annoying interruptions and interference by the soldiers in possession of the premises.



The great advances in educational facilities and the rapid institutions of new Universities and Colleges throughout the other countries of Europe and in America, became an object lesson, not only to the people of Vienna, but to all Austria. The University was without a home and many of its departments had no regular place for work, lectures being delivered even in private houses, and the quarters occupied by the Observatory in the old part of the city were unsuitable and entirely inadequate for its growing demands.

These conditions were repeatedly called to public attention and a general desire became manifest for radical amelioration in all departments of the University.

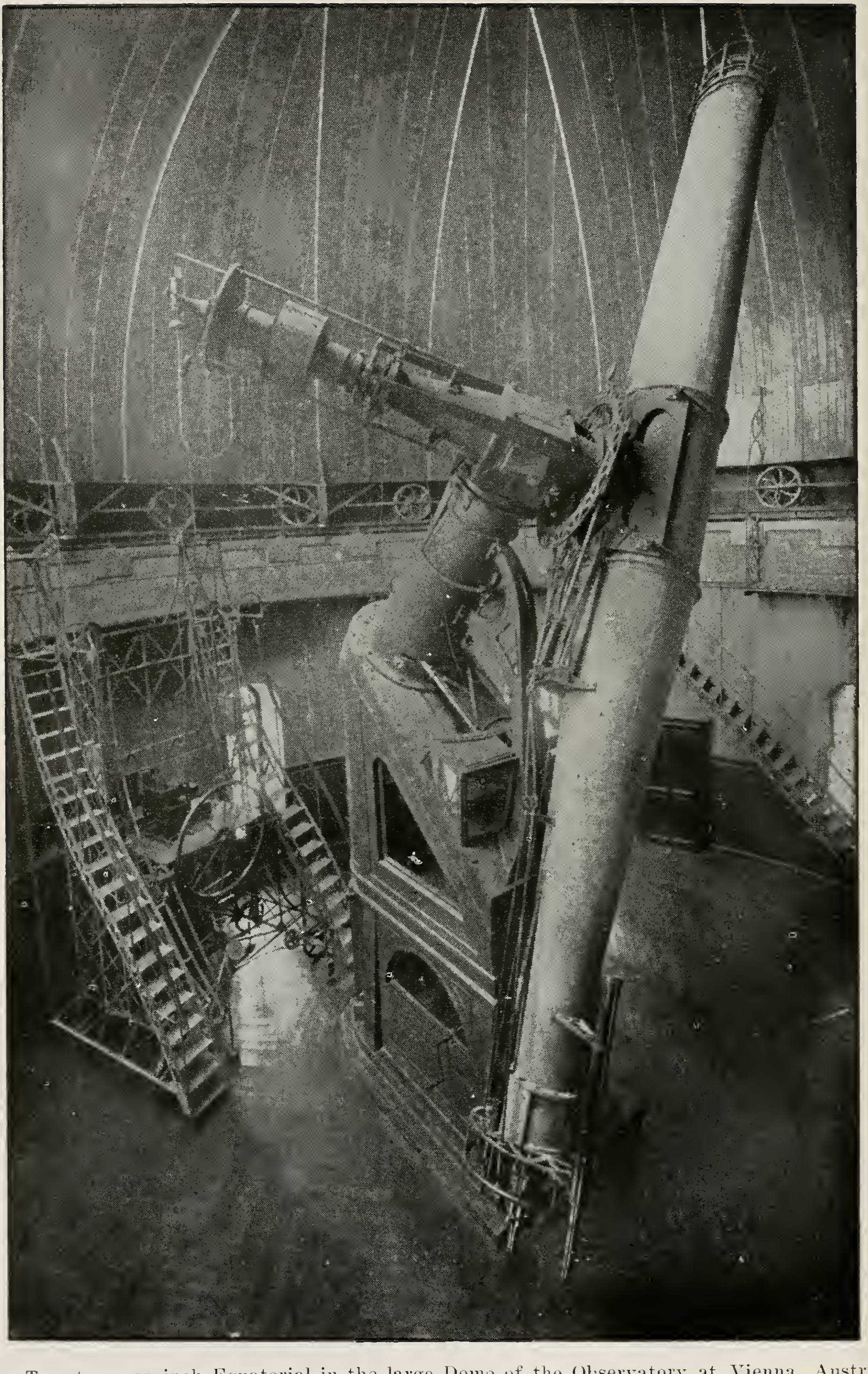
In 1872 Mr. Strehmayer, Minister of Education, a gentleman of liberal culture, broad ideas and a strenuous advocate for all improvements tending to the advancement of the higher education, obtained from the Parliament an appropriation for the purchase of a site for an Observatory, the erection of a suitable building and the securing of instruments and appliances of the latest designs.

The government paid for the tract selected, two hundred and fifty thousand crowns, equivalent to fifty thousand dollars. Its present value is not less than one hundred and seventy-five thousand dollars. It comprises a portion of the district called Türkenschanze (literally, the camping field of the Turks), upon which the Turkish army of over 200,000 men, under Kara Mustapha, was encamped during the famous siege of Vienna in 1683. The dirt wall of one of the Turkish redoubts, now covered with trees, partially surrounds the building occupied by the photographic instrument. The entire enclosure, embracing about sixteen and three-fifths (16 3-5) acres, is surrounded by a high ornate brick wall, with two artistic wrought-iron arched gateways.

In 1883 Emperor Francis Joseph I. formally placed the last stone of the noble edifice which now overlooks Vienna from the apex of the loftiest elevation in the Northwest portion of the city.

The cost of this structure was two million crowns ($400,-000). It is of brick, three hundred feet in length by two hundred and eight feet across the two wings, in the shape of a cross, with four domes.

The living rooms of the Director's family, his offices, the working rooms of the observers and assistants, and the Library are in that portion fronting south, which forms the foot of the cross. Entrance is under a spacious porch, into a fine hall lighted through a glass roof, at the east side of which is a marble tablet reciting:



The Twenty-seven inch Equatorial in the large Dome of the Observatory at Vienna, Austria

"Erbaut
Unter
Sr. M. Des Kaisers
Franz Josef I.
1874-1880."

(Erected under His Majesty the Emperor Francis Joseph I. 1874-1880.)

On the west side a tablet reads:

"Begonnen
Unter
Dir. Karl v. Littrow
Vollendet
Unter
Dir. Edmund Weiss
Nach den Plänen
der Architekten
Fellner & Helmer."

(Commenced under Director Karl von Littrow, completed under Director Edmund Weiss, according to the plans of the Architects Fellner & Helmer.)

A pleasant flight of granite stairs leads to the main floor paved with mosaic, from which a hall conducts to the large circular room in the center of the cross, through which, from the solid rock, four metres below, ascends the massive pier upon which, under the great dome, forty feet in diameter, rests the objective of 27 inches, with a focal length of 30 feet. A stairway winds around the pier, reaching the observing floor.

This refractor was mounted by Grubb, and it was the first large instrument with which the vernier of the hour circle could be read from the eye end without the necessity of ascending to the axis of the tube for that purpose.

In the large circular hall, at the west of the pier, is placed the transit instrument, and in the dome at the west arm of the cross, is the Clark 11 3-4 objective.

The North dome, on the top of the cross, had for many years a comet seeker, but this has lately been removed and substituted by a short focus instrument for coarser photographic work of a general character.

The East dome contains the old six-inch equatorial which had done its work from the roof of the Academy of Sciences building. It was the largest instrument owned by the Observatory College prior to its removal to the present location.

In an alcove at the Southeast side of the large circular hall, are several smaller objectives, which can be easily moved to an adjacent exterior stone platform for use by the idle curious and others, when the larger glasses are not at disposal.

A smaller building in the Western part of the grounds contains an excellent instrument for photographic work of more precise definition.

The Observatory (or Sternwarte—in the national vernacular, meaning literally, waiting for the stars,) forms a department of the Vienna University, and theoretically, is subject to the same general governing authority that controls all the other departments; but, practically, it is independent and conducted entirely under the direction of Dr. Weiss.

Lectures by Professors Weiss and Hepperger are delivered at the University building on Franzensring during the first semester, upon the general principles or introduction to the study of astronomy, but throughout the second semester, instruction is given at the Observatory in practical work, the use of the instruments, observations and calculations.

The expenses are met by appropriations from the Parliament, which, however, are seldom large enough to meet the demands constantly arising by reason of the rapid advances in the science, more particularly in the lines of photography and astro-physics. When the present Observatory was completed, celestial photography was in its childhood; the spectrum had not yet been applied to the equatorial and the word astro-physics had not been coined. With the exception of the zone of the Asteroids, the discovery of a new body or of a double star was a rare event, and the instruments purchased were adapted for use on the lines of the older astronomy. Observatories were not then, as now, located all over the earth; the losing track of a celestial body was considered a serious matter, and, therefore, the principal work of this Observatory has been in observations of comets, the planets and the moon; in correcting old errors regarding nebulae; charting the positions and orbits of the planets, and the comparison of later observations with those of Herschel, with considerable attention to the double and variable stars.

Professor Weiss has long been desirous of having the facilities for celestial photography and astro-physics. He has sent his assistants to England and other places to acquire the necessary information and skill, and he has also labored with tongue and pen to obtain the instruments necessary for this work. But these are expensive, and the necessary funds have not been forthcoming, for so many demands are made upon the public treasury by the numerous institutions of learning, that the Minister of that department of the government who has such matters in his care, has not yet been able to secure from Parliament an appropriation sufficiently large to meet the wishes of Dr. Weiss, although during the last year an excellent photographic instrument was secured and placed in a new building erected West of the main structure.

The Library of the Observatory embraces about ten thousand volumes and between five and six thousand pamphlets, among which are many valuable calculations, observations and other documents from the fertile brain of Professor Weiss, during his long, illustrious and most honorable career.

Transactions of the Academy

JANUARY, 1908.

Owing to the unavoidable absence of the Secretary, the minutes of the January meeting were not preserved.

FEBRUARY, 1908.

At the regular meeting of the Academy, February 3rd, the topic for consideration was "Archeological Researches in the Southwest," and was presented in most attractive and instructive form by Dr. George La Monte Cole, a gentleman who has given many years of his life to this field of investigation, with systematic and intelligent thought. Dr. Cole is an enthusiast in his specialty, and communicates the same spirit to those to whom he speaks. His lecture was greatly enriched by stereopticon views of many of the most rare and interesting specimens of archeological study, confirming his statement relative to the extreme richness of this section ot the country in tangible evidences of prehistoric man.

MARCH, 1908.

The evening of March 2nd was spent by the members of the Academy in imagination amid the wild grandeur and magnificence of the Sierra Nevada Mountains, under the leadership of Mr. Russ Avery, who recounted in eloquent terms the experiences of a party of young men on a vacation trip to the highest and roughest regions of this splendid mountain range. Aided by the stereopticon, scenery unsurpassed on any continent was brought home to the auditors with an enthusiasm that was contagious, and which thrilled all present with a sense of patriotic pride in the matchless grandeur of our mountains, valleys, streams, and forests. The exhilarating joys of outdoor exercise and the fascinating freedom of camp life formed a conspicuous feature of this instructive lecture.

The following Preambles and Resolutions were unanimously adopted, viz:

Whereas, the Southern California Academy of Sciences received some months ago, through Mr. Holdridge O. Collins, Secretary of the Astronomical Section, a valuable contribution from Professor Simon Sarasola, S. J., of the Observatory of Belen, at Havana, Cuba, entitled "Estudios sobre el nefelismo en la Habana," presenting the result of important observations made by Rev. Laurent Gangoiti, S. J., Director of the Belen Observatory, relating to cloud formations over the West India Islands, and predictions of disastrous storms, verified in a remarkable manner;

And, Whereas, the above contribution was duly translated into the English tongue and read before this body by Mr. William A. Spalding, former President of this Academy, an authority on meteorological phenomena, and favorably commented upon by him, now, therefore,

Be it Resolved, by the Southern California Academy of Sciences, in

regular session assembled, that the thanks of this Body be tendered to Professor Simon Sarasola, S. J., for his valuable contribution; and,

Resolved, further, that a copy of these Resolutions, together with a translation of his scientific paper, which was used, be forwarded to Professor Sarasola.

APRIL, 1908.

The subject of discussion on this evening was "The applications of Electricity," especially to wireless telegraphy, and was most fully and ably presented by Prof. Twining of the Polytechnic High School. The lecturer introduced his subject by a general discussion of the all-pervading ether which occupies space, affording the medium of transmission of waves of heat, light and electro-magnetism from one cosmic body to another. He claims that ether is without weight, weight being a condition and not a quality of matter. The difference between fundamental and harmonic waves in ether was well illustrated by vibrations of a rubber rope made to vibrate both as a whole and in sections at the same time. The characteristic differences that distinguish the various forces that are transmitted by ether are due to differences in wave length and in frequency.

The speaker described the various forms of transmitters, transformers, condensers and other electrical apparatus, to be used in his experiments, and then proceeded to demonstrate some of the most striking effects of high-frequency electricity. His illustration of the principles and methods involved in wireless telegraphy was most vivid and satisfactory, showing clearly the capacity of the atmosphere to transmit electro-magnetic waves that may be made by proper apparatus to subserve the interests of man in the communication of thought. It is worthy of mention that all of the apparatus used in the various experiments on this occasion was constructed by students in the scientific department of the Polytechnic High School.

MAY, 1908.

The Academy met in regular monthly session, the Secretary in the chair. After preliminary announcements for the guidance of the Academy, he introduced President B. R. Baumgardt, who proceeded to address the Academy on the "Overthrow and Reclamation of Pompeii." The speaker gave a vivid historical account of the conditions prevailing in the ancient city previous to the memorable catastrophe, and of the physical aspects of the then long extinct volcano of Vesuvius. He painted in glowing colors the dreadful magnificence of the scene as beheld by Pliny from Cape Misenum, when the great mountain belched forth flame and smoke and ashes, and lava, to the imminent peril of the cities upon its slope, and pictured the awful consternation that prevailed as Herculaneum and Pompeii were entombed by the overwhelming avalanche of lava in the one case and the rain of ashes in the other. He pointed out that this distinction in the cause of the overthrow has made the difference in the method and difficulty of reclaiming the two cities. Herculaneum having been overwhelmed by lava, is held in the grip of a glassy cement, as hard as flint, which must be chiseled away by a slow and tedious process; while Pompeii, having been enveloped by falling ashes, is readily exhumed by pick and shovel.

The speaker then unfolded to the view of the audience, by means of exquisite stereopticon slides, the strange yet fascinating scenes of this ancient center of Roman fashion and art and culture. The streets and houses, the frescoes and statuary, the domestic utensils and evidences of social refinement, were presented with striking naturalness, and decribed in terms so clear and direct as to place the auditors in imagina-

tion amid the very living activities of this historic spot of antiquity. The lecturer took occasion to exhibit slides that depicted the scenes of cruelty, tyranny and debauchery that have made the name of Caligula, Emperor of Rome, odious for all time to come. The lecture was replete with interest and information, and was received with marks of the highest appreciation.

At the close of the lecture the members proceeded with the annual election, and the followin-named gentlemen were unanimously chosen as directors for the year ending June 30, 1909, viz:

Bernard R. Baumgardt, Melville Dozier, B. E. Beeman, John D. Hooker, F. D. Bullard, Samuel J. Keese, Holdridge O. Collins, William H. Knight, John S. Vosburg, William L. Watts, C. A. Whiting.

At the subsequent meeting of the directors the following officers were elected:

President—Bernard R. Baumgardt.

First Vice-President—William H. Knight.

Second Vice-President—John D. Hooker.

Treasurer—Samuel J. Keese.

Secretary—Holdridge O. Collins.

JUNE, 1908.

At the final monthly meeting of the Academy President Baumgardt presided and called for the report of the Secretary for the past year. The Secretary presented an abstract of the proceedings of the Academy during the year just closing, and his report was accepted by the Academy with thanks. The report of the Treasurer being called for, was presented in satisfactory form, showing a small balance on hand. The thanks of the Academy were presented to the Treasurer for his very efficient services during the year. The President announced the generous gift of one hundred dollars toward the current expenses of the Academy from Vice-President John D. Hooker.

He then gave a brief account of the progress being made by the Director of Mount Wilson Observatory, and his assistants, stating that the sixty-inch lens had been successfully transported to the mountain top and is being mounted for use. He also stated that the great one hundred-inch lens donated by Mr. Jno. D. Hooker, has been successfully cast in Paris, and is now on its way to its final resting place on Mount Wilson. It will probably require two years to complete its polishing and mounting.

A paper by Holdridge O. Collins, Secretary of the Astronomical Section, upon the Astronomical Observatory at Vienna, and the work of Professor Edmund Weiss, was received with great attention. Mr. Collins is now sojourning in Vienna, and the courtesies extended to him by Prof. Weiss have enabled him to give a very interesting account of that great Observatory.

The lecturer of the Evening, Dr. Theodore B. Comstock, ex-president of the Academy, was then introduced, and delivered a most scholarly address on the "Music of Evolution." He went fully into the theory of the genesis of matter, endeavoring to demonstrate that as matter in its various combinations assumed the forms now extant, a certain law of development is traceable which bears a striking resemblance to the relation of the various notes in an octave of music.

Dr. Comstock's lecture evinced extensive research, and was highly technical, both in matter and composition. At the close of the lecture the Academy adjourned to assemble again the first Monday in October, 1908.

MELVILLE DOZIER, Secretary.

OCTOBER, 1908.

The general meeting of October 5, 1908, was called to order by the acting Secretary, who congratulated the Academy upon the propitious opening of the new academic year, and bespoke a generous support of the meetings of the Academy during the coming year.

Announcements of the monthly meetings of the several Sections were made by the chairmen of the respective Sections, the Biological Section being prepared to announce its entire program for the year, and the fact that its meetings during the coming year would be held in the rooms of the University Club, at 349 South Hill street.

The subject for consideration this evening was Lake Tahoe, its geological environment, some historic data, and its scenic charms.

An interesting address was delivered by Vice-President Knight, setting forth the history and geology of this magnificent sheet of water, filling a great basin in the midst of tne highest and grandest of the Sierra Nevada Mountains, being twenty miles long, twelve miles wide, and 1700 feet deep. The scenic beauties of the place, ranking among the finest of the globe, were most charmingly portrayed by stereopticon views of surpassing loveliness. These views appealed both to the artistic sense and the patriotic pride of the audience, and were enjoyed to the utmost.

MELVILLE DOZIER, Acting Secretary.

NOVEMBER, 1908.

There was no meeting of the Academy in November.

A called meeting of the Directors was held at 4:30 o'clock P. M., on Friday, November 27, 1908, in the office of the Academy, room 625 San Fernando Building. All the Directors were present except Bullard, Vosburg and Dozier.

President Baumgardt announced the appointment of the following Committee on Publication, viz: Holdridge O. Collins, Chairman; Anstruther Davidson, William H. Knight.

It was ordered that hereafter the Bulletin be regularly issued in January and July.

Mr. Bruce Hatch and Prof. H. La V. Twining were elected members.

The Treasurer was authorized to rent quarters in the San Fernando Building for the permanent office of the Academy.

Hofrat Professor Doctor Edmund Weiss, Director of the Kaiserlich Koeniglich Sternwarte (Imperial Observatory) at Vienna, Austria, was unanimously elected an Honorary member of the Academy.

The Secretary was authorized to cause all complete sets of the Bulletin to be bound, and distributed to such scientific Bodies as he may select from the list of those desiring copies.

DECEMBER, 1908.

The December meeting of the Academy was held in Symphony Hall on the seventh of the month, President Baumgardt in the chair. Notice was given of the meeting of the Biological Section on December 14, and the Astronomical Section on December 21. The President announced the arrival at Pasadena of the casting for the lens of the Hooker 100-inch reflector.

In the discussions of the subjects for the evening, Dr. F. C. Mattison spoke upon Public Health Work, and he dwelt particularly upon the scientific application of methods for combating disease, particularly tuberculosis. The necessity for bringing home to the people, particularly the poorer classes, a perfect understanding of the gospel of cleanliness, and the precautions to be taken in the family to prevent the spread of contagious and infectious diseases; the inspection of all

kinds of food, particularly in populous centers, and a stern regulation of the dairies. His scientific discourse was supplemented with striking incidences of the difficulty of obtaining appropriations from legislative bodies for carrying on this work, when matters of trivial importance received liberal donations.

Dr. George H. Kress, secretary of the Public Health Commission, gave a most interesting history of the discovery of the means by which yellow fever and the bubonic plague are disseminated, illustrating his talk with stereopticon views of the mosquito and the rat flea, and the domestic fly, and he expatiated upon the work in San Francisco of exterminating the rats. His stereopticon views over the city, of the pall of carbon soot and chemical gases, so fatal to cleanliness, comfort and health, thrown out by the chimneys of the manufacturing plants of greedy corporations, and the engines of the Southern Pacific Company in open defiance of the ordinances and the repeated protests of the city officers, were a most striking object lesson. He showed what good work had been done, even with the limited means at his disposal, in the inspection of small hotels and cheap lodging houses, where were found no means of ventilation, and no attempts made for cleanliness in the furniture, bedding or carpets, and which were becoming centers for the dissemination of disease. A great advance for the health of the community would be made by the establishment of public baths and comfort stations, and the consent of property-owners to the rat-proofing of buildings by concrete floors.

The milk question was an important feature of the discourse of Dr. Kress, and he explained how rapidly diphtheria, tuberculosis, scarlet fever, diarrhoea and other diseases are carried to a community by impure milk. The difference between the regulated and inspected sanitary dairy and the foul sheds of the milk pirate, the inevitable source of disease and death, was most vividly exhibited upon the screen.

In showing the work of the City Health Office, Dr. L. M. Powers, Health Officer, emphasized the vital necessity of a proper disposal of the garbage, and the difficulty of inculcating an appreciation among citizens, especially in the poorer districts, of their danger in allowing filth and decaying food to collect about their habitations. He was much encouraged by the change for the better in the water and milk supply of this city by reason of the power given to inspectors by the late statutes.

All the discourses of the evening were of the most absorbing interest, and received marked attention by the audience. Vice-President Knight announced the subject for the January meeting to be "The Romance of Man; Epochs in His Intellectual Evolution," by President Baumgardt.

JANUARY, 1909.

At the meeting of the Academy on January 4, Mr. B. R. Baumgardt gave an address on "The Intellectual Evolution of Man," illustrated with lantern views. He commenced with examples of the rhythmical processes in all departments of nature, and he showed that human progress was governed by the same laws.

Mankind has had stages of intellectual activity, and then for a time came a rest, and even a seeming retrogression. He divided history into six epochs. Disregarding the early Aryan development of Asia, the dawn may be said to have been ushered in from four to seven thousand years before the

Christian Era, in the Valley of the Nile. Here, learning was confined to the priests who handed down their knowledge from generation to generation, some of it being preserved in the hieroglyhpics on their monuments.

The second epoch culminated in the Greek civilization of Pericles, Aristotle, Archimedes and other Greek philosophers, and in the perfection of the arts of Sculpture and Architecture. This embraced a period from the fifth to the second century before Christ.

Arabia and the followers of Mahomet, under the general title of Saracens, developed a high civilization in northern Africa and southern Europe during the first seven centuries of our era, constituting the third epoch. They founded the world's first University in Southern Spain, and the first Astronomical Observatory at Cordova.

The fourth epoch was the renaissance, beginning with Dante in the thirteenth century, and covering 200 years of wonderful art development in the Italian peninsula.

The fifth epoch included the work of the greatest mathematical geniuses of the world—Copernicus, Kepler, Newton, Laplace, and their contemporaries.

The sixth epoch embraces the application of science to modern art, and the consequent amelioration of the condition of man.

HOLDRIDGE OZRO COLLINS,
Secretary.

ASTRONOMICAL SECTION.

Owing to the absence in Europe of the Secretary, no record was preserved of the proceedings of the Astronomical Section from January to June, 1908.

The first meeting after the Summer vacation was held on October 19, 1908, jointly with the Geological Section in the lecture room of the University Club. The subject of the evening, "Luni-Solar Influences in Producing Volcanic Eruptions," was presented by Mr. William A. Spalding in an elaborate paper, and was generally discussed by a large audience.

The section assembled for the November meeting at 621 Witmer street, and listened to a thoughtful presentation by Mr. Knight upon "Geotherms, or Sources of Heat Beneath and Within the Earth's Crust." Careful observations made in different countries seem to establish the fact that in shafts sunk to a depth of one mile or more the temperature increases as depth is reached at the ratio of one degree Fahrenheit for every 60 feet of descent. If this ratio of heat-increase persists, the temperature at a depth of 45 miles will be about 6,000 or 7,000 degrees, great enough to fuse all known substances, and if the pressure of the superincumbent shell or crust

amounting to two and a half tons to the square inch were removed, this hot core of material would instantly vaporize and envelop the earth in a hot, perhaps glowing gas. In considering the origin of this extreme heat, it is assumed that it was primarily derived from the heat generated by the condensation of the original earth nebula, but that the slow cooling of the mass may be due to the presence of radio-active substances, whose slow disintegration evolves large stores of heat.

It has been found that the wonderful new element radium is always associated with uranium in minerals containing the latter substance, and it is believed to be a product of the disintegration of that metal. There are several other radio-active elements such as thorium, polonium, actinium, and all of these are found to pervade many of the rock formations, especially granite. This may account to a large extent for the maintenance of present temperatures in the earth's crust.

"Some European Observatories" was the theme for the December meeting. Mr. Baumgardt described the Observatories at Athens, Paris, Stockholm, and Pulkowa with an account of the work accomplished at those places.

Mr. Collins gave an account of the great Observatory at Vienna and his warm reception by the Director, Professor Edmund Weiss: Of his ascent to the summit of Galileo's Tower in Florence, from which was first seen the four satellites of Jupiter, and of his examination of the little world-renowned telescope in the Specola Natural History Museum at Florence, exhibited to him by the Director, Prof. Constantino Pittei: Of the very pleasant attentions shown him in Rome by Signor Elia Millosevich, the Italian Astronomer Royal, in throwing open for his inspection the Observatory, working rooms and offices erected on the dome of St. Ignatius Church, which forms one corner of the large group of structures in which was located the famous Collegio Romano. From this Observatory the Jesuit Priest, Father Secchi, made his discoveries, and here, in his adjoining private apartments on the roof of the church, he died, February 26, 1878, seven years after the Italian government had driven out the Jesuit owners, shame and the fear of ridicule from the whole Astronomical world preventing the authorities from dispossessing this learned scientist of the place he had made so famous.

Pope Leo XIII gave to the German professor, P. Giovanni Hagen, S. J., the charge of establishing a new Observatory in the private grounds of the Vatican Palace, and the work commenced before Leo's death has progressed steadily under the encouragement and material assistance of Pius X. Here upon the towers of the old walls, which, in ancient days, formed a part of the defenses around St. Peter's Church and the Vatican, commanding an unobstructed view of the heavens from the

entire circle of the horizon, have been constructed three domes, in which are to be mounted modern refractors, the largest of which will have an objective of 16 inches diameter.

The pleasure of the visit to this place, to which access is seldom gained by the "profanum vulgus," was greatly enhanced by a most cordial reception and the personal attendance and explanations from Professor Hagen. He was greatly interested and impressed with the accounts given him of the nearly completed 60-inch Reflector and the great 100-inch Hooker Reflector then in process of construction, both of which were to be erected upon Mt. Wilson.

An amusing incident at the close of this visit was the insistence of the Professor that his visitor should subscribe his name in a beautiful, gold-clasped, leather-bound volume containing the autographs of Pope Leo XIII, and of a large number of the most famous scientists of modern times, who have visited this place; and there is his name as Secretary of the Astronomical Section of the Southern California Academy of Sciences.

HOLDRIDGE OZRO COLLINS,
Secretary.

BIOLOGICAL SECTION.

The Biological Section has held regular monthly meetings during the last year, except in June, July, August and September.

At these meetings questions of technical biological interest were discussed by a succession of able lecturers; those who spoke being Dr. E. L. Leonard of the U. S. C. Medical College, Prof. Esterly of Occidental College, Dr. C. A. Whiting of the Pacific College of Osteopathy, Prof. Miller of the State Normal School and Dr. Hanson of South Pasadena.

During the summer the program committee of the Biological Section provided for an unusually fine course of lectures on bacteriology, and the subjects discussed up to the January, 1909, meeting were as follow, viz.: "The Place of Bacteria in Nature and Their Classification," October 12th, J. Park Dougall, M. D. "How Bacteria Grow, Cultures and Culture Media," November 9th, Ethel L. Leonard, B. S., M. D. "The Relation of Bacteria to Disease," December 14th, J. Park Dougall, M. D. "Theories of Immunity," January 11th, Ethel L. Leonard, B. S., M. D.

The program for the remainder of the year will embrace the following subjects: "Bacterial Sera and Vaccines," February 8th, Carl C. Warden, M. D. "The Opsonic Index and Its Relation to Disease," March 8th, Geo. Martyn, M. D. "Suppurative Processes," April 12th, C. W. Anderson, M. D. "Tuberculosis," May 10th, A. O. Conrad, M. D.

C. H. PHINNEY,
Secretary.

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OF THE

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Southern California Academy of Sciences

COMMITTEE ON PUBLICATION:

Holdridge Ozro Collins, LL. D., Chairman.
Anstruther Davidson, C. M., M. D. Frank D. Bullard, M. D.

CONTENTS:

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ROOM 625 SAN FERNANDO BUILDING

Southern California Academy of Sciences

Officers and Directors, 1909-1910

WILLIAM A. SPALDING	President
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Frank D. Bullard
Anstruther Davidson
George W. Parsons
William L. Watts
Clement A. Whiting

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W. H. Storms, Chairman — G. Major Taber, Secretary

Biological Section

Clement A. Whiting, Chairman — C. H. Phinney, Secretary

Zoological Section

James Z. Gilbert, Chairman — George W. Parsons, Secretary

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Anstruther Davidson, Chairman

Editorial

The revival of interest in the growth of Eucalyptus has been very general throughout Southern California, and a great demand now exists for all reliable publications relating to this genus of the vegetable kingdom.

Probably the general public attention was first called to the value of this plant by the First Biennial Report of the State Board of Forestry, of which Mr. Abbot Kinney was Chairman. In September, 1896, this Academy published a very interesting volume on Eucalyptus, by Mr. Kinney, which was profusely illustrated with excellent half-tone views of many species. Numerous requests for this work have been sent to this Academy, but we are unable to supply copies, as the entire edition has been distributed. In 1902, the United States Department of Agriculture published a very extensive illustrated volume on "Eucalyptus Cultivated in the United States," by Alfred James McClatchie, M. A., which is now in great demand, but this also has become one of the scarce books.

In 1903, Dr. J. H. Maiden, Government Botanist of New South Wales and Director of the Botanic Gardens, Sidney, commenced the publication of "A Critical Revision of the Genus Eucalyptus." That work was issued in twelve parts, and was completed in 1908. It is very elaborate, voluminous in its text, describing all the known species, and illustrated with large and exquisite plates. This Academy has been the grateful recipient of a copy presented by Dr. Maiden.

During the last winter, there have been upon exhibition in Los Angeles, collections of various species of Eucalyptus grown in California, which have opened the eyes of manufacturers to the value of the harder wood varieties for furniture, agricultural implements, felloes and all parts of the wagon, and for polished hardwood interior decoration.

To most people, the title, "Blue Gum," appears to be the name for all Eucalyptus trees, but this is only one of more than one hundred and fifty species of the genera. It has two distinctive blossoms, one a pale orange and the other, white

SEP 9 - 1909

with delicate cream yellow anthers. The exquisite flower of the Eucalyptus ficifolia and miniata is a brilliant crimson blossom, and nearly all the Eucalyptus blossoms with their numerous stamens, somewhat resemble the night-blooming cereus, on a minute scale, and they are worthy of a prominent place in all floral displays.

The Eucalyptus in California has a very rapid growth, and in very few years arrives to a condition of commercial value—I will not say maturity—for, like the Sequoia gigantea, it appears never to cease growing. In all its species it is very prolific, and Mr. Kinney, in "Eucalyptus," says that "in an ounce of well-sifted blue-gum seeds there will be 10,000 fertile grains." In 1891 I brought from Riverside a plant of the Eucalyptus citriodora—commonly called the "lemon-verbena," about the diameter of my thumb and the length of a walking cane, which I planted in rear of my residence in Los Angeles, and today that tree is over one hundred feet in height, seven feet and nine inches in circumference, one foot from the ground, and it is the most striking landmark in St. James Park.

In this Bulletin we present a paper by Mr. Kinney, treating the economic side of Eucalyptus culture, and a reprint of a valuable article on "Antiseptic Vegetation for Cuba," by A. Campbell Johnston, originally published by this Academy in September, 1899.

The Story of Ab, that captivating romance by Stanley Waterloo, of events during the paleolithic age, when England was a part of the Continent and when the battle for the Survival of the fittest was being waged the most fiercely, has entertained the evening fireside of old and young and the brain and heart of many profoundly learned in Biology, Geology and Ethnology. It is worthy of a place as well in the library of the most learned as being a most valuable contribution to juvenile literature.

A young lady of Los Angeles, who can lawfully add to her name the College degree of Bachelor of Literature, and who is admired in her social sphere as much for her brilliant intellectual attainments as her charming personality, upon receiving a copy of Ab, returned the following clever acknowledgment:

To thank you for Ab, is my pleasure specific,
That anthropological tale scientific
About hirsute men of such vigor magnific:
They battled with mammoths and serpents terrific,
At a time when it seemed even beasts insectivic
Were not, as they are in our day, insignific.
This strenuous, hardy folk paleolithic,
Who jumped, not evolved, to the age neolithic,
And made themselves homes in great caves stalactitic,
Or migrated to valleys thro' plains sulphurific,
Have left us as records no altars sanctific,
Such as Druids erected—great piles monolithic,
Only middens and weapons and utensils pacific.
Now pray do not nod o'er this verse soporific.

The organization of a Section of Zoology marks a new era in the life of the Academy. Professor James L. Gilbert, Chairman of the Section, well known in this community for his scientific attainments, is at the head of the Biological Department of the Los Angeles High School, and during the short period of the life of this Section he has accomplished wonders. It has been known for some time that in a depression on the Rancho La Brea, are buried the remains of early fauna of California. A communication from the Academy to Mrs. Erskine M. Ross, owner of the rancho, requesting permission to excavate at this place, brought a most gracious consent, and, owing to the liberality of Mr. John D. Hooker, Prof. Gilbert was able to proceed at once with the work. An opportunity so rare comes but once, and we are fortunate that we have been able to delve in so rich a bed of extinct fauna at the very door of the Academy.

On Monday, July 26, 1909, Prof. Gilbert placed upon exhibition in the City Hall the results of his work since the commencement of the public school summer vacation. A Buffalo skull, with a sweep of horns of 31 inches from tip to tip, the largest ever found; the bones of the Camel, Horse, Antelope, Sloth and Elephant in their most gigantic forms; a skull of the sabre-toothed tiger, complete in all its parts; the head and part of the bones of a huge lion—not the mountain lion of California, but of the African type; smaller cats, rodents and a large variety of birds, great and small, were shown in an unusually excellent state of perfection. None of these are petrified, and their preservation from a time before man made his appearance is explained by their burial in a grave of brea.

This exhibit was inspected by the Mayor and the gentlemen of the City Council, who were so impressed with the value of these discoveries and the fear that the numerous foreign Scientific Bodies, which have applied for permission to excavate in this wonderful deposit, will carry away fossils which should forever remain in a home Museum, that, on the same day, an appropriation of five hundred dollars was made to the Academy for the continuance of this work.

Holdridge Ozro Collins.

Jupiter's Equinoxes and Sun Spots

By William A. Spalding.

About the year 1825, Heinrich Samuel Schwabe, an amateur astronomer of Dessau, Germany, began to observe and record sun-spots. He pursued his investigation for twenty-five years, and, in 1851, published the results of his labors. From the data thus presented a periodicity in sun-spot phenomena was first deduced. The subsequent investigations of Prof. R. Wolf of Zurich, and others, confirmed the deductions of Schwabe, fixing the period from maximum to maximum at approximately 11 1-9 years.

This close approach to Jupiter's period of revolution—11.86 years—at once directed suspicion to that planet as the inciting cause of sun-spot phenomena, and, **pari passu,** other members of the solar system were involved in the inquiry.

De La Rue, Stewart, and other investigators, attacked the problem with great vigor, and promulgated theories assigning sun-spot phenomena to the perturbative influence of various planets, or to the influence of several planets when in conjunction; but the theories thus proposed have not been accepted by the scientific world, because they are not considered as conclusively proven.

In 1886, J. H. Kedzie published a book entitled, "Speculations on Solar Heat, Gravitation and Sun-Spots." He presented a theory that the period of maximum sun-spots is in some way correlated with Jupiter's passage of the perihelion point in his orbit; i. e., the closest approximation of that planet to the sun. His tables, however, showed a wide range of variation, and he was compelled to admit that the period of maximum sun-spots seemed to lag considerably behind Jupiter's perihelion passage.

Following the investigations of De La Rue and Stewart in their efforts to attribute the cause of sun-spots to the joint influence of various planets, Prof. John H. Tice, Superintendent of Public Schools of St. Louis, Mo., in 1862, took up this line of research, with the hope of discovering the cause of the eleven years sun-spot period and also of extending the inquiry to see whether there might be a similar periodicity in telluric and atmospheric disturbances. In other words, his hypothesis was that the same great cause lies behind sun-spots, magnetic

and electrical disturbances, earthquakes, volcanic eruptions, hurricanes, tornadoes and atmospheric disturbances of all kinds. This cause he assigned to the equinoctial perturbation proceeding from the various planets of the solar system. After an investigation extending through twelve years, Prof. Tice, in 1875, published a treatise on Meteorology, setting forth his theory and the results of his observation and research. This treatise, while challenging respectful consideration, is not presented in such a logical and well-digested manner as to be considered convincing testimony in support of his theory.

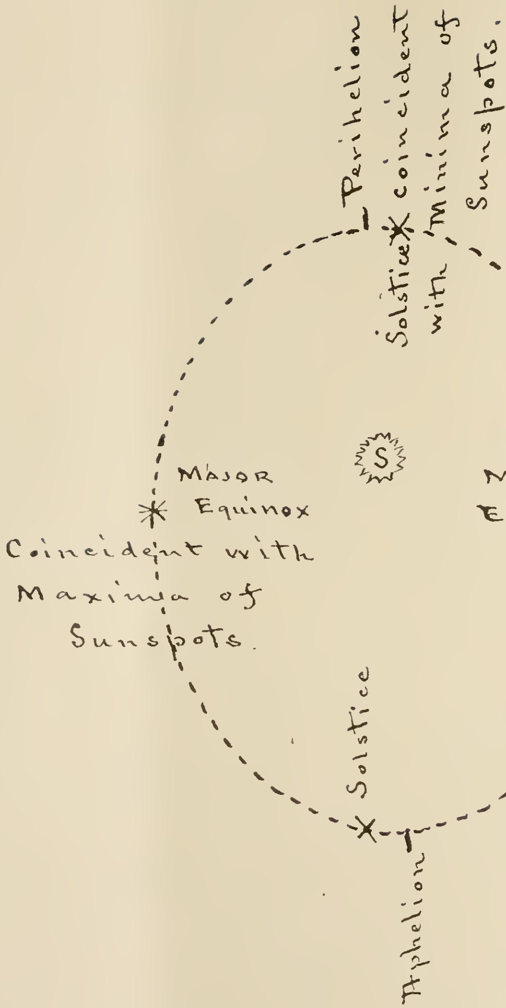
Thus the investigation has drifted until the present time without attaining results that are regarded as conclusive. The cause of the eleven years sun-spot cycle remains as much a mystery as ever.

In 1890 I obtained Prof. Tice's work on Meteorology, and was so much impressed with the reasonableness of his theory that I engaged in a serious study of the subject, which has been prosecuted with more or less constancy during the subsequent years. It seemed to me that the great desideratum was to first make a demonstration of physical facts. Is there an actual concurrence between Jupiter's equinoctial passage and sun-spots? It ought to be possible to demonstrate this proposition so thoroughly that there would no longer be a reasonable doubt on the subject. The physical facts being first established, a theory would be forthcoming; perhaps several theories.

In this paper I attempt to show that there is a very close and well-sustained approximation in dates between Jupiter's major equinox and maxima of sun-spots; also, as a corollary to the foregoing, that there is a close and well-sustained approximation between Jupiter's solstice near the perihelion passage, and minima of sun-spots. This constitutes a double demonstration in support of Prof. Tice's theory.

The equinoxes of Jupiter, like those of the earth, occur approximately midway between the perihelion and aphelion points in his orbit. The equinox which succeeds the perihelion passage is termed Jupter's major equinox. This equinox is nearly coincident with sun-spot maxima.

The solstice which approximates Jupiter's perihelion passage (corresponding to the earth's winter solstice) is taken as the point nearly coincident with sun-spot minima. The following diagram will serve to illustrate our thesis:



Jupiter's Orbit – Showing Aphelion, Perihelion, Solstitial and Equinoctial Points

The most reliable data concerning sun-spots begins with Schwabe's observations about 1825 or 1826, and extends down to the present time. The older data generally embodied in tables were collected by Wolf, about 1850, long subsequent to the events. According to Prof. Young, Wolf rummaged in attics and unearthed scraps of astronomical records, taken mainly with no idea of periodicity, and with these he pieced out, as best he could, the earlier part of the table, from 1610 to 1826.

In the following table we have taken Schwabe's data of sun-spot maxima from 1837 down, supplementing his table with authenticated later records, in order to institute a comparison between these dates and the dates of Jupiter's major equinoxes:

Major Equinoxes of Jupiter.	Sun-Spot Maxima.	Difference.
1836.16	1837.2	+1.04
1848.02	1848.1	+ .08
1859.88	1860.1	+ .22
1871.74	1870.6	—1.14
1883.60	1883.9	+ .30
1895.46	1894	—1.46
1907.32	1906-7 (?)	(?)

In the above table when the sun-spot maximum is subsequent to the equinox the difference is indicated with a plus sign; when the maximum preceds the equinox, the difference is marked with a minus sign. The greatest variations are +1.04 and —1.46 years, and the average of all is only .706—say an average difference of only eight and one-half months. This covers a period, in the definite comparison, of fifty-seven years. Including the 1906 or 1907 date, which, when results are calculated, will probably show a close approximation, the entire period covered is seventy years. This seems long enough to constitute a very fair investigation. No other comparison of an astronomical event with sun-spot maxima has shown such a close coincidence.

The equinoxes of Jupiter being nearly midway between the perihelion and aphelion points, it follows that the solstitial points must nearly coincide with the perihelion and aphelion points in his orbit. According to Prof. Tice, the solstices of

Jupiter should indicate the periods of least solar disturbance; the solstice which is nearly coincident with the perihelion passage being taken as corresponding to the present recognized period of minimum sun-spots. We have accordingly prepared the following table to institute a comparison between Jupiter's solstice corresponding to the earth's winter solstice (near perihelion) and the sun-spot minima. Wolf's data are taken for sun-spot minima, and Tice's for Jupiter's perihelion dates which the solstice approximates:

Jupiter's Solstice near Perihelion.	Sun-Spot Minima.	Difference.
1832.11	1833.9	+1.79
1843.97	1843.5	+ .47
1855.83	1856	+ .17
1867.69	1867.2	— .49
1879.55	1879	— .55
1891.41	1889.6	—1.81
1903.27	1901.5	—1.77

Greatest + variation 1.79
Greatest — variation 1.81
Average + ... .81
Average — 1.15
Average of all .... 1.+

Here, as before, when the sun-spot minimum precedes the solstitial date, the difference is prefixed by a minus sign; when the sun-spot minimum follows the solstitial date, the difference is prefixed by a plus sign.

In the above table the approximations are not so close as in the preceding, but still close enough to be quite remarkable. This, at any rate, constitutes a double comparison, which tends to sustain our position from both points of observation.

Prof. Tice allows three years for the duration of an equinoctial disturbance of Jupiter—three-fifths of that time before and two-fifths after the equinoctial passage—so that the variations found in the first table come well within the limit allowed.

To make this showing of approximations more evident, we present the following graphic diagram:

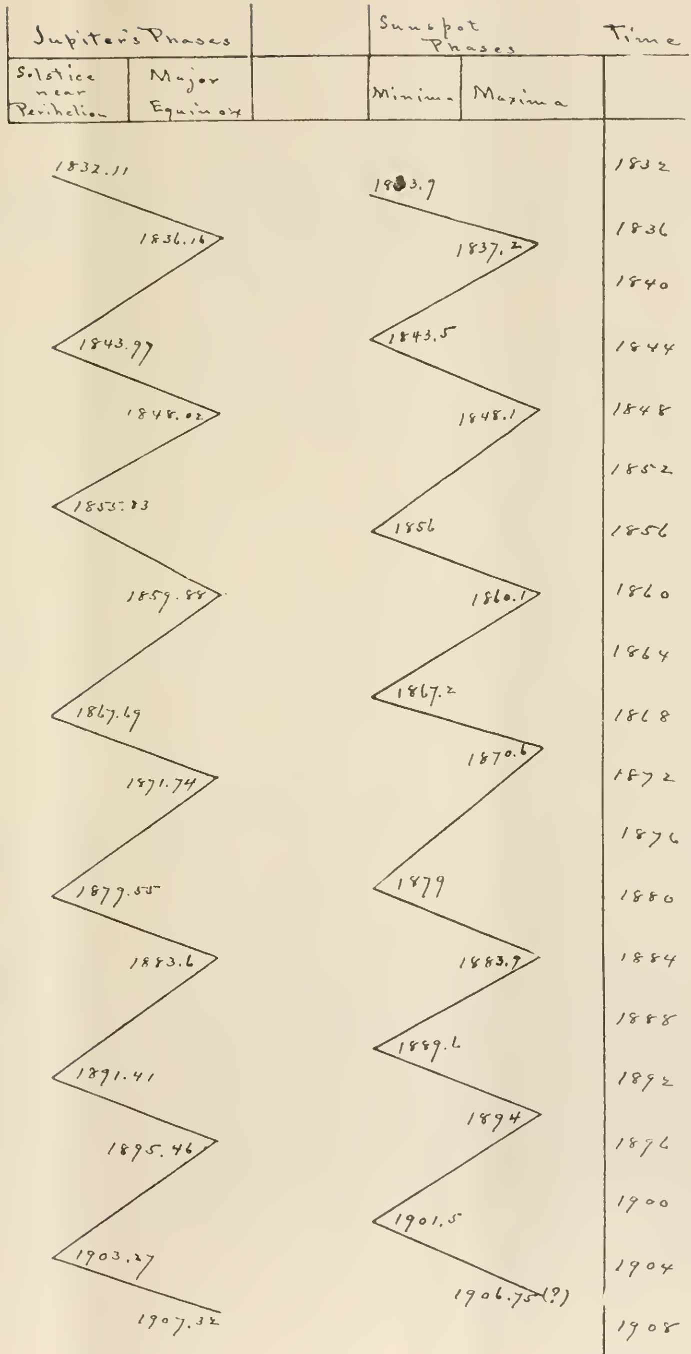


Diagram Showing Correlation of Sunspot Phases and Phases of Jupiter

The Variation of the Compass in Southern California and the Difference of Time Between the Tides at San Pedro and San Diego

By B. R. Baumgardt.

The Astronomical Section has frequently been asked to supply a table of the local variations of the compass. In reply the following information is indicated:

Los Angeles	14.6 East
Santa Barbara	14.7 East
Barstow	14.7 East
San Diego	13.6 East
Yuma	13.5 East

As these variations of the compass are all toward the East, they must be applied to the right of the magnetic bearing.

The variations of the compass are not constant in any part of the world. Locally, the secular change is exceedingly small and may be neglected.

Tides

The interval between the moon's transit and succeeding high water for our two Southern California harbors is as follows:

San Diego (mean interval)	9h. 38m.
San Pedro (mean interval)	9h. 39m.

The difference in the lagging of the tides between the two harbors is, as will be seen, exactly one minute.

The difference between the maximum and minimum interval is, for the two respective harbors,

San Diego	1h. 35m.
San Pedro	1h. 48m.

a difference of 13 minutes.

Chronology of the Bulletin

The publication of the Bulletin of the Southern California Academy of Sciences was commenced in 1902, and has been continued down to the present time, embracing 8 volumes, viz.:

VOLUME I, 1902.

Nos. 1 to 10 inclusive, for the months of January to August, November and December, with Supplement Index.

VOLUME II, 1903.

Nos. 1 to 9 inclusive, for the months of January to June, October, November and December, with Index.

VOLUME III, 1904.

Nos. 1 to 9 inclusive, for the months of January to June, October, November and December, with Index.

VOLUME IV, 1905.

Nos. 1 to 9 inclusive, for the months of January to June, October, November and December, with Index.

VOLUME V, 1906.

Nos. 1 to 3 inclusive, for the months of March, June and December, with Index.

VOLUME VI, 1907.

Nos. 1 to 2 inclusive, for the months of March and July.

VOLUME VII, 1908.

Consists of only No. 1, January.

VOLUME VIII, 1909.

Nos. 1 and 2, for the months of January and July, with Index.

Index to Volumes VI and VII was sent out with the January number of Volume VIII.

The Academy will make a liberal exchange, or pay a reasonable price for monthly Numbers of Volumes III, IV, V and VI of the Bulletin, which are needed to complete files, for which there are many requests.

Eucalyptus for Hardwood

By Abbot Kinney.

Popular interest in the planting of Eucalyptus has increased. This increased interest is due to the realization of the proximate exhaustion of the Native American hardwoods. Our hardwoods are not only becoming scarce and expensive, but no new natural supply is in sight. Nor will the care of the forester fully remedy the situation. This is because of the slow growth of the Native hardwoods. The Eucalypti alone give any promise of filling any portion of the growing demand for hardwoods within a reasonable time.

The genus Eucalyptus is native to Australasia. Australia and Tasmania are the source of supply of all the species known to be of commercial value. Not one species of Eucalyptus is native to New Zealand, and only a few are found in New Guinea, Timor and neighboring tropical islands near Australia.

None of the species will tolerate much frost. Eighteen to twenty degrees Fahrenheit is the limit of safety for the hardiest commercial kinds.

The commercial planting of Eucalyptus is consequently restricted to California or so nearly so, on account of climate, that we can say that within the United States, California has a natural monopoly in the commercial production of the trees of this genus.

The most valuable species of Eucalyptus have several exceedingly attractive qualities for private commercial planting.

The first of these is rapidity of growth. It is a moderate statement that the E. globulus or common blue gum will produce a good crop of wood in from ten to fifteen years.

Second—The Eucalyptus in the Californian experience will produce well in solid plantation of one kind or species. The importance of this will be realized when the fact is recalled that the general forestry practice is to plant other hardwoods in mixed plantations for good results. The economy of handling solid groves of one kind of tree is an important advantage that the Eucalypti so far have been found to have in California.

Third—Rapid growth from the stump after cutting. There appears to be no limit to the number of times that most Eucalyptus trees will make a new and valuable growth.

This new or pollard growth should be thinned out about

the second year, and again about the fourth or fifth, and the main commercial crop would be due again about the seventh year.

Fourth—The Eucalypti in California are free for all practical purposes from parasites or fungi. The appended article from the U. S. Department of Agriculture indicates the importance of this characteristic:

How Hardwoods Decay.

"Hardwood trees in the forests are attacked by many enemies. The mistletoe, the 'witches' broom,' and the southern mosses are all parasites that weaken and even destroy the trees. But by far the greater number of diseases of trees are caused by fungus growth. Some fungi destroy the leaves, some rot the roots, and some girdle the bark. Chestnut orchards have been destroyed in many places in the East by a kind of fungus which girdles the bark and kills the tree.

"Then there are many kinds of fungus which rot the wood of standing trees, with no outward sign until after the value of the tree has been destroyed. The white heart-rot is the most common of these. It attacks the oak, walnut, hickory, beech, maples, and many other trees. The heartwood of the tree is changed by the action of the fungus into a light-colored, flaky sort of substance which has no strength and can no longer be called wood. Such a tree may live for many years, even though badly diseased, but it has no value for timber.

"The outward sign, when it does appear, is a shelf-like growth upon the trunk. It is hoof-shaped, about as thick as wide, and may be anywhere from one to two inches wide to twelve inches or more. The upper surface runs from brown to black, the lower surface from gray to red-brown. Wherever such a tree is found it should be removed at once, for the longer it stands the less it is worth for timber, and it will surely spread the disease to other trees. Any sort of wound in a sound tree, such as a broken limb, gives an opening for the fungus to enter and establish itself, unnoticed until the heartwood is destroyed. Wherever such a wound can be promptly coated with hot coal-tar creosote, or some other good antiseptic substance, it may be saved from infection."

Fifth—The sanitary influence of Eucalyptus plantations is good. The general effect of the blue gum in particular is to reduce or remove conditions leading to malarial disease. They have been planted for this particular purpose in Italy near Rome, in Corsica, and in Algiers.

The leaves of the blue gum, E. globulus, are the recognized reliable source of Eucalyptus oil and its product, Euca-

lyptol. It is a powerful antiseptic and is used for this purpose, and is also a valuable medicine.

The market for Eucalyptus oil appears to be reliable. As a consequence, the blue gum grove has a value not shared by other species. When the trees are cut, the leaves can be distilled cheaply, and in skillful hands the oil will pay all the cost of cutting a grove into firewood and of the distilling. If the grove is cut for a better market, the value of the oil is equally profitable.

In planting Eucalyptus for profit, a great deal of study and care should be given to the character and quality of the soil, to the climate and to the need of water and the cost of the same where irrigation is required for a full and quick return.

E. rostrata or the red gum, and E. tereticorius, stand the most heat and cold, and are therefore the best trees with others of their type for our arid districts.

In the coast valleys practically all species of Eucalyptus do well. The only exception known to us, so far, is the celebrated "Jarrah" of Southwestern Australia. This is the E. Marginata. We have no record of a successful planting of this species.

There is always something of a fever amongst us Americans when a new and promising thing is brought to public attention. The Eucalyptus planters are liable to this fever, even if they are free from other fevers, through the Eucalyptus oils. Care and investigation should be the rule with investors. There seems, however, no way to overdo hardwood plantations in this country.

PUBLICATIONS

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CONTENTS:

Antiseptic Vegetation for Cuba

BY

A. CAMPBELL JOHNSON

Chairman of the Botanical Section

LOS ANGELES, CAL.

SEPTEMBER, 1899

Antiseptic Vegetation for Cuba

The word antiseptic is applied to vegetation planted for the purposes of killing germs, either in the ground or air, and combating the ravages of fever and disease. The late Baron Ferdinand von Müeller first made use of this word which so aptly describes the various genera of Myrtaceous vegetation now recognized as one of nature's great gifts to mankind. For over forty years he devoted his life to the classification of the flora of Australia, at that time almost unknown to the world, and he himself attributed the salubrity of the coast climate of Western Australia largely to the prevalence of Myrtaceous trees and shrubs. As yet it has hardly been definitely settled how this is accomplished; but recognizing the presence in these plants of volatile oil, the purification of the soil and air is probably accomplished partly by drying up unhealthy swamps, and possibly the roots directly feeding on the destructive germs contained in the soil, and partly by the diffusion of an antiseptic ether, deadly to these germs; partly also by the direct absorption and deodorizing action of the leaves. It is not, however, my intention here to enter into the chemistry of the oils of the Melaleucas or Eucalyptus, as little is at present known as to the former; and as regards the latter, much yet remains to be investigated, and also it is not yet definitely settled how this vegetation favorably affects climates.

Before proceeding directly to discuss the various plants recommended for trial, we would like to suggest the conditions we would have to meet in Cuba. The United States Government has already been making some inquiries, and I think it is especially timely for the Academy of Science of Southern California to collect and classify the information we have, especially as our President, Mr. Abbot Kinney, has written what is now the standard work on the successful introduction of the Eucalyptus (one great genus of antiseptic vegetation), and, with Mr. Elwood Cooper and other pioneers, has so widely distributed the various species that they now form one of the chief features of our Southern

California landscape. I am inclined, however, to believe the conditions which prevail in Cuba are somewhat unusual At Havana harbor one of the great difficulties the late Colonel Waring (who so nobly gave up his life in investigating these conditions) had to contend with was the prevalence of marsh lands, over which the sewage of the city had to pass, and the exposure of these mud flats during low tide, and one of his recommendations provided for the draining and reclamation of these mud flats. And possibly, for the amelioration and improvement of health conditions in other parts of Cuba, the United States would have largely to deal with somewhat similar conditions. Assuming this to be somewhat the case, I have placed the genus Melaleuca, one branch of the great family of Myrtaceae, first on the list as worthy of trial, because some of the most useful species extend into tropical climates, and because, in the Manuel de l'Acclimateur, by Charles Naudin and Baron Ferd. von Müeller, the standard work on plants adapted to the different climates of Europe and tropical countries, it is stated, in describing one species, that "This Melaleuca grows vigorously in earth impregnated with salt water where no Eucalyptus could live, and it does much to ameliorate the unhealthfulness of the climate. *This remarkable attribute* ought to recommend its culture in colonies established near marshes or lagoons in countries surrounding the Mediterranean Sea, principally in Algeria." He goes on to mention several other species which are equally valuable, and which I will refer to in detail.

The first to recommend will be the Melaleuca leucadendron. From the leaves of this and allied species or varieties is distilled the oil of cajeput, an essence generally green, with a somewhat agreeable and very penetrating odor, employed from time immemorial in Chinese India, externally and internally, for rheumatism, nervous affections, malignant fevers and cholera. A very nearly allied species, Melaleuca virideflora or niaouli, of New Caledonia, extends as far north as the Indian Archipelago. Besides oil and bark it furnishes the natives with building timber, and in utility is to this country what the Eucalyptus is to Australia. These various forms are sometimes united as only varieties of Melaleuca leucadendron, sometimes given specific rank.

Melaleuca minor, in Java and Molucca, also produces oil. Melaleuca cajuputi, long considered as only a form of Melaleuca leucadendron, is found in the Indian Islands as far west and north as the southeast coast of Borneo. It is in the islands of Borneo and Ceram where the two largest forms are found, and the leaves and bark are used by the natives. The tree stands out in the forest, having a white bark like birch bark. The

number of the closely allied species or forms, spreading from Western Australia from latitude 34° almost to the tropics, would justify a belief in its extreme adaptability to various conditions. I note the following description by J. H. Maiden: "It is called in Australia White Tea-tree, is a large, shapely, umbrageous tree, which has broad leaves and white or creamy flowers, and which is found in nearly pure sea sand, or by the side of brackish creeks." I have recently received a specimen of this tree growing in San Diego.

We have perhaps another form of it in our parks in Los Angeles. Among others recommended are Melaleuca ericifolia, making quite a tree; Melaleuca linariifolia, somewhat common in our parks in Los Angeles; Melaleuca genistafolia, all suitable for trial.

The genus Melaleuca comprises over one hundred species, many of them worthy of trial. Before leaving this attractive genus it may not be out of place to touch on the great beauty of many of them. Dr. Franceschi, an importer of new, useful and ornamental plants, tells me that at Naples this was almost the only plant used for decorating the summer villas erected on a promontory of land reaching out into the sea. Nothing else would withstand the direct sea breezes. Two specimen trees of this genus, Melaleuca Huegeli, nearly sixty feet high and the stem four feet in circumference, and Melaleuca cuticularis, twenty feet high and nearly five feet in circumference, are well known trees in the Cape Town Botanical Garden. It may also be found that the Callistemons, a very nearly allied genus, may provide some trees worthy of trial. A tree of Callistemon speciosus, nearly twenty feet high, is one of the sights of Santa Barbara.

Before discussing the Eucalyptus, I would like briefly to refer to a few more genera which may be included under the head of antiseptic vegetation. Leptospermum loevigatum, also known as Fabricia laevigata, is well known in San Francisco from being largely used in reclaiming the sandy soil of the Golden Gate Park. It makes quite a tree, and with Leptospermum lanigerum is recommended by Charles Naudin, who says it is supposed to have the effect of driving away malaria from swampy places, and fulfills the same health giving role as Melaleuca ericifolia and many of the Eucalypti. L. flavescens extends as far north as the Philippines, and several other species extend to the Northern portion of Western Australia and are suitable for experiment. The leaves of L. scoparium were used infused as tea by Capt. Cook and his crew on his voyage of discovery.

Another genus belonging to the Myrtaceae, probably the most widely spread over the various islands of the Indian Archi-

pelago and Oceanica, are the Metrosideros and Xanthostemon. Of the latter, twenty-five species are endemic to Australia, ten in New Caledonia, and one (X. verdugonianus) in Mindanae. Indeed, it is probable that several useful Myrtaceous plants might be introduced from the Philippines. The Metrosideros polymorphia, named on account of its varying types, forms the most generally prevailing trees on the Hawaiian Islands between 1500 and 5000 feet. Metrosideros vera is one of the iron woods of Molucca; Syncarpia laurifolia, now classed with the Metrosideros, is one of the most valuable shade trees of Australia. But, though all the dry capsular seeded forms of the Myrtaceae may prove valuable, I think enough has been suggested, and I will proceed to the discussion of the Eucalyptus, which undoubtedly, in the higher mountainous regions of Cuba, will be most successful; and some few species may prove valuable in the tropical lagoons near the coast.

With the consent of Mr. Abbot Kinney, the author of a work on the Eucalyptus, I make use of much of the data he has collected that directly applies to the introduction of this family of trees into tropical countries. Prof. Charles Naudin says:

"The introduction of the Eucalyptus into tropical countries has up to now been only moderately successful; more especially have they failed where the heat is almost uniform and the humidity of the atmosphere very great. Speaking generally, the Eucalyptus requires a season of rest, either by reason of a fall in the temperature or a prolonged dry season. There are, however, a few species which seem to have succeeded in the tropics, which we note in the following descriptions:

E. abergiana possibly can be acclimated in tropical countries.

E. capitellata succeeds in wet sand, and may be used where the climate is not too unfavorable.

E. resinifera is one of the Eucalyptus which best succeeds in tropical climates. It has been successful in India at Lucknow.

E. terminalis comes from tropical Queensland and may succeed in other tropical countries." This completes Charles Naudin's list.

Mr. Abbot Kinney states:

E. calophylia succeeds in the moist tropics of Zanzibar, but its leaves are very deficient in oil.

This seems rather a small list, but it by no means follows that out of one hundred and fifty species known that many have been tried. Even in our experiments with sixty or seventy species in California, we have great surprises. No doubt from the extraordinary divergence from types we find in seedlings, in an extended trial some would be better adapted to these apparently adverse conditions, and owing to the early production of

seed a new generation could be introduced in a few years that would succeed. I would recommend especially for trial E. Corymbrosa, found in forests associated with E. abergiana, and also I would especially recommend E. alba, a species extending to the islands north of Australia, particularly interesting, as perhaps, forming a link between the Melaleucas and Eucalypts. It is stated that Cajeput oil is sometimes distilled from its leaves.

Owing to the difficulty of sprouting all Myrtaceous seeds of trees, the least humidity in the air, or rain damping off the young seedlings, it would be more desirable to ship plants from California when well established, in pots. We have growing here nearly seventy species of Eucalypts; also some twenty-five to thirty other Myrtaceous plants suitable for experiment. In no other region in America have so many plants of this great Australian family of Myrtacea been introduced. This is owing to their finding here so congenial a home.

In conclusion I would ask the Academy of Sciences of Southern California to endorse the establishment of a Botanical Experiment Station near Los Angeles, or in our parks, for the following reasons:

Because vegetation recognized as antiseptic is largely Western Australian, and trees from this region have been so uniformly successful here. In no other portion of America do so favorable climatic conditions prevail.

Because *the investigation* of these various growths and their comparative antiseptic value would confer on mankind and the American people a greater benefit than any other experimental station by promoting health and prosperity in regions now almost uninhabitable for the Anglo-Saxon race.

A. Campbell Johnston,

Garvanza,
Los Angeles, Cal.

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Abbot Kinney.

Tropical Agriculturist.

South Limits of Coast Range Trees.—I.

By Willis L. Jepson.

The greatest development of forest and woodland in California occurs in the Mendocino and Humboldt areas. This fact is not only true as to the number of individuals and the size of individuals, but it is also true as to the number of species composing the forest in the north coast district. Nearly all of the species composing this great coast forest are derived from the north and have their south limits in Humboldt or Mendocino counties, sometimes in Sonoma County. A few others, as we definitely know, go as far south as Marin or cross the Golden Gate to the Santa Cruz and Santa Lucia mountains.

Going back to our classical authority on the Botany of California, viz., the volumes of the State Geological Survey, we find a reference of still other species to Marin County, Santa Cruz mountains and the Santa Lucia mountains as the south limits, but without indication of definite stations. These various statements of south limits have since the days of the Botany of California been so faithfully copied from one monograph and text into another that the mere sense of literary authority seems now to place them beyond challenge, and yet many of these stations may well be brought under profitable scrutiny and question at the present time.

Tsuga heterophylla Sarg. The Coast Hemlock is attributed to Marin County in the Botany of California, vol. 2, p. 121, the reference to Geo. R. Vasey resting (inferentially) upon specimens collected by him. This species could not well grow in Marin County, except on the western slope of the Bolinas Ridge, between Muir woods and Tocaloma, a botanically well explored region, where, although searched for, it has not been located. Having never seen it myself, I have made inquiry of many devotees of the Marin woods, but always with negative results. The statement of Miss M. E. Parsons, who resides at the base of Mt. Tamalpais, may be regarded as typical: "I have never seen the Coast Hemlock in Marin County. I made inquiry of my friend, Robert Menzies of San Rafael, who immediately said that he and his friends had had frequent discussions upon that point, and that they had come to the conclusion that the supposed occurrence of the tree in Marin was a myth. Mr. Menzies is an ardent lover of trees, a keen observer and a great tramper, so I should give his experience serious consideration."

Taxus brevifolia Nutt. The Western Yew is attributed to

the Bay of Monterey by Sargent (Silva N. Am., vol. 10, p. 65). on the shores of which it is unlikely to occur. Anderson gives a station (Laguna Creek) in his Santa Cruz County list; otherwise, definite localities are unknown, south of the Bay of San Francisco. The sharp, deep cañons of the western slope of the Santa Lucias offer a suitable environment for Western Yew, and further search may well be made for it in this region.

✓ Torreya Californica Torr. The south limit of the California Nutmeg, as at present known, is in the Santa Cruz mountains. The following note regarding occurrence in this range has been furnished by Robt. L. Pendleton: "Hume Cañon, several small trees about 15 to 20 feet high, 1000 feet elevation; Norton Cañon, small trees, numerous but scattered, between 1000 and 1500 feet; Saratoga Cañon, small trees, scattered, between 1000 and 2000 feet. One small tree near the summit of Castle Rock Ridge, Santa Cruz mountains, 2800 feet. This is the only tree near the summit for several miles. All of the above are on a north slope in quite thick forests of the main Castle Rock Ridge, or the single mountain northeast, which lies between Saratoga and Los Gatos, and are in Santa Clara County. There is one station in Santa Cruz County, on a ridge about two miles southwest of the Saratoga summit. Here there is a good deal of fog and so the trees grow in more open country, although still on the northerly slope. I have also learned of a specimen which is growing along the coast near the mouth of the Waddell Creek, Santa Cruz County, which has a trunk about a foot through, and resembles Psendotsuga in habit."

This species has also been observed by the writer in Archibald Creek Cañon, within a few miles of the Santa Cruz coast, the trees more numerous than seen elsewhere, and varying from saplings to trees past maturity, the latter 85 to 105 feet high, and 4½ to 7 1-3 feet in circumference at 4 feet above the ground.

Thuja plicata Nutt. The southernmost definite station for the Canoe Cedar, so far as known, is on the northerly slope of the Bear River Range, south of Ferndale, near the sea, in Humboldt County; I saw it here in 1902. The trees grew near what is called the Wild Cat grade, and were about 75 feet high. The spray-like branchlets drooping in close or compacted bunches gave the appearance, at first glance, that the trees were wilting. I have never observed this species in the Coast Range woods southward; although attributed to Mendocino County in Sargent's Silva, vol. 10, p. 130, no exact station is given. It is, indeed, not at all improbable that it may exist in Mendocino County, but it is certainly rare enough to be

worthy of the distinction of an exact station. In the Botany of California, vol. 2, p. 115, the following statement occurs: "Rather rare in California. It is said to range from San Diego County to Sitka." The San Diego error goes back, doubtless, to John Torrey and C. C. Parry in the Botany of the Mexican Boundary Survey, p. 211, who, in all probability, confused the species in question with Librocedrus decurrens.

Quercus garryana Hook. The Oregon Oak forms a considerable part of the mixed forests of Humboldt, Mendocino and Sonoma counties inside the Redwood Belt. It also grows on the northerly slopes of Mt. Tamalpais, in Marin County. I know of no exact station south of San Francisco Bay, nor have I seen it in the Santa Cruz or Santa Lucia ranges. It may well occur on the higher slopes of the Santa Cruz mountains, where it is said by Sargent (Silva North America, vol. 8, p. 30,) to exist, but he does not cite a definite locality. There is also a possibility that it may be found in the Santa Lucias in some favorable situation.

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Transactions of the Academy

This record is continued from page 42, Volume VIII, of the Bulletin, January, 1909.

FEBRUARY.

At the meeting of the Academy on February 1, 1909, a very large audience gathered at Blanchard Hall and listened with intense interest to Professor George E. Hale, who described the late work on Mount Wilson and the results, so far obtained, of his observations of the sun.

The construction of the Snow Reflector and the newly completed 60-inch Reflector, with their housings was explained and views of the sun-spots showing their right and left-handed vortices and the hydrogen flocculi were thrown upon the screen. These observations seem to prove, almost conclusively, the existence of a magnetic field in sun-spots, and the polarization of the light, both from these spots and from other portions of the sun's surface will undoubtedly give results which will be the foundation for the examination of the constituent qualities of the stars.

The enormous light-gathering power of the new 60-inch Reflector and the sharpness of its power of definition were shown in the photograph of the great nebula of Orion, the most wonderful celestial photograph ever taken, and exhibited this evening before this Academy, for the first time. This photograph is to be shown to the Astronomical Bodies of Europe by Prof. Hale during the coming summer.

The investigations by means of these powerful telescopes have already begun to show the origin of the stars and planets; their condensation from nebulae and their evolution through periods of time—illimitable to us—to a condition when the star blazes in its full maturity, and its satellites, or planets, are the homes of vegetable and animal life, through old age, extinction and death.

It is the proud distinction of this Academy to place upon record the first public declaration of the results of the examination of our sun, the stars and nebulae, by means of this 60-inch Reflector.

The following communication from Hofrat, Professor, Doctor Edmund Weiss, Director of the Vienna Observatory (Sternwarte), was read and received with pleasure, viz.:

"Vienna, 16 January, 1909.
"XVIII Spottlegasse 19.

"The Southern California Academy of Sciences, Los Angeles.

"I return my sincere thanks to the esteemed Academy of Sciences for the honor which she has conferred on me by the election as Honorary Member—an honor which I highly appreciate.

May I add that it will always afford me a great satisfaction if I can assist the Academy in her scope and endeavors to promote sciences, and that I will send henceforth my papers to her Library.

"I conclude in expressing to the Academy of Sciences my hearty wishes in the motto of our Universities,

"Vivat, Floreat, Crescat,

"PROF. DR. EDMUND WEISS."

With hearty thanks to Prof. Hale, the Academy adjourned.

A meeting of the Directors was held in Blanchard Hall at 7:45 o'clock P. M., on February 1, 1909, at which E. H. Rose and Dr. Thomas A. Rex were elected members.

Professor George E. Hale and Dr. J. H. Maiden of Sidney, New South Wales, were elected Honorary Members of the Academy, and the Board adjourned.

A meeting of the Directors was held at Room 625, San Fernando Building, on Thursday, February 11, 1909, at 5 o'clock P. M.

In the absence of the President and both Vice-Presidents, Dr. Whiting was elected chairman.

Judge F. W. Gregg, Dr. Andrew S. Lobingier, Daisy D. Hayden, L. M. Whiting and Olive Clarke were elected members of the Academy.

The subject of charging an admission fee to the general public at the monthly meetings of the Academy, proposed by Mr. Keese, was discussed, but action was deferred so that it could be presented at a meeting when all the Directors shall be present.

The Board adjourned, subject to the call of the Secretary.

MARCH.

The regular meeting of the Academy for March was held in Blanchard Hall before a large audience, members and citizens.

Captain Amos A. Fries of the Engineer Corps of the United States Army, who is in charge of the Government works at San Pedro, addressed the meeting upon the subject of "San Pedro Harbor, Past and Future: Its Commercial Possibilities, Proposed Fortifications and its Consolidation with Los Angeles."

His discourse was illustrated with maps and drawings, and his explanations of the present condition of the Harbor, and the proposed additions and improvements by the Government and by private enterprise, were most lucid and interesting.

At the close of the lecture the Captain was put upon the witness stand and subjected to a searching cross-examination by individuals in the audience, which brought out many facts which have not been generally known. For an Army Officer, the Captain proved himself a pretty good Lawyer, as he explained in a very clear manner the laws, Municipal, State and National, relating to the Harbor, its front or dockage lines, its tide lands and approaches.

A hearty vote of thanks was given him by the audience.

A meeting of the Directors was held on Wednesday, March 17, 1909, at 4 o'clock P. M., in the office of the Secretary, Room 625, San Fernando Building.

Present—Messrs. Baumgardt, Beeman, Collins, Keese and Whiting.

The record of the previous meetings of the Directors was read and approved.

The Secretary reported that he was corresponding with Dr. David Starr Jordan and there was a prospect of securing him as the lecturer for the April meeting, 1909.

The President reported that Dr. G. Martyn had been secured for the May or June meeting.

A communication was received from Mr. Samuel Fox, relating to a proposed excavation in the Rancho La Brea, west of the City of Los Angeles, which is owned by Mrs. Ida Hancock, and the Secretary was instructed to inform Mr. Fox that while the Directors are in full sympathy with this project, there are no funds subject to their control which are available for this purpose.

Board adjourned.

APRIL.

At the April meeting of the Academy, held in Symphony Hall, Dr. Norton J. F. Hazeldine spoke upon the religions of the people of India and he illustrated his discourse by quotations from a literal translation of the Rubaiyat of Omar Khayyam. From his intimate association from childhood with the priesthood and leaders among the

highest intellectual element, he showed that a profoundly religious sentiment, and a belief in a spiritual existence after death, prevails throughout those lands, and that, among teachers, the materalist is unknown; that Fitzgerald's translation of the Rubaiyat gives an entirely incorrect idea of the religious thought of the East.

MAY.

The Annual meeting of the Academy was held in Symphony Hall, May 3, 1909, and the following named gentlemen were elected Directors for the ensuing year, viz.:

Bernhard R. Baumgardt, Frank D. Bullard, Holdridge O. Collins, Anstruther Davidson, John D. Hooker, Samuel J. Keese, William H. Knight, George W. Parsons, William A. Spalding, William L. Watts and Clement A. Whiting.

The subject of the evening was "The Opsonic Index, or the Role of the Blood in the Vaccine Treatment of Consumption," which was presented by Dr. George Martyn.

The lecturer explained Nature's method of producing immunity from infectious diseases and he dealt with the scientific facts discovered by the great teachers from Jenner, Pasteur and Lister, up to Metchnikoff, Koch and Wright, connecting the discovery of vaccination with the modern treatment of Tuberculosis by tuberculin; the cause of Nature's break-down under the ravages of infection and the scientific means of restoring the balance between health and disease.

From the nature of the subject, it was necessarily technical, but it was listened to with marked attention by the audience, among whom were many of the most prominent physicians of the city.

The discourse was illustrated by drawings and X-rays views of lungs in conditions of disease and health.

An animated and interesting discussion ensued upon the close of the lecture, in which were shown the necessity of separate Hospitals and retreats for the treatment of Tuberculosis, and the constant danger to the public by the neglect to furnish suitable means for adequate treatment of this dreadful disease.

Immediately after the adjournment of the Annual Meeting of the Academy, the Directors elected for the ensuing year, 1909-1910, were called to order, and the following Officers were unanimously elected, to-wit:

William A. Spalding .... President
William H. Knight .... First Vice-President
John D. Hooker .... Second Vice-President
Samuel J. Keese .... Treasurer
Holdridge O. Collins .... Secretary

The President appointed the following Standing Committees, viz.:

Publication.

Holdridge O. Collins, Chairman.
Dr. Anstruther Davidson. Dr. Frank D. Bullard.

Program.

William H. Knight, Chairman.
George W. Parsons. William L. Watts.

Finance.

Samuel J. Keese, Chairman.
Bernhard R. Baumgardt. Clement A. Whiting.

A meeting of the Directors was held on May 25, 1909, at one o'clock P. M., in room 625, San Fernando Building. Present: Messrs. Spalding, Collins, Davidson, Knight, Parsons and Watts.

It was decided to have the next meeting of the Academy, the last before the Summer vacation, on June 2, 1909, in Blanchard Hall. That admission shall be by tickets, of which each member shall have two, all others to be charged twenty-five cents for admission. As an illustrated lecture on Venice will be given by Mr. Baumgardt, Messrs. Knight and Watts were appointed a committee to see that publicity be given of the occasion by the city newspapers.

The invitation from Mr. Abbot Kinney for the Academy to hold a special meeting at Venice was accepted, and Saturday, June 19, was fixed for that event. The Secretary was authorized to consult with Mr. Kinney, make due arrangements, and give notices to members. The Secretary was also authorized to solicit advertisements for publication in the Bulletin.

Mary M. Bowman was admitted to membership.

Board adjourned.

JUNE.

The June meeting, 1909, was held in Blanchard Hall on the second of the month. Owing to a misunderstanding as to the rent of the hall for the evening, it was necessary to omit all business matters, as we were required to surrender possession at ten o'clock, and the Annual Reports of officers were not presented.

Announcement was made by the President of a meeting to be held on June 19, 1909, in Venice, at which the business of the past year will be terminated.

Mr. B. R. Baumgardt delivered an interesting and instructive lecture on Venice (Italy), illustrated by beautiful views upon the screen.

A meeting of the Academy was held in Venice on Saturday, June 19, 1909.

At 3:30 o'clock, P. M., in the Hall of the Venice Chamber of Commerce, on the Ship Cabrillo, the Academy was called to order by President Spalding, and an address of welcome was made by the Secretary of the Chamber.

The Annual Report of the Secretary was read and ordered to be printed in the Bulletin.

Dr. Andrew Stewart Lobingier delivered a very interesting discourse upon the "Economic Position of Public Sanitation," which was listened to with profound attention.

Short addresses were made by President Spalding, B. R. Baumgardt, Abbot Kinney, H. P. Barrows and William L. Watts.

After adjournment the members were entertained by Mr. Kinney with an inspection of the various places of amusement in the city.

A meeting of the Directors was held on Monday, June 28, 1909, in Room 625, San Fernando Building, President Spalding in the chair.

A resolution was unanimously adopted authorizing B. R. Baumgardt, who is about to depart for Europe, to purchase on behalf of this Academy, at least 400 slides for projecting purposes, and at least 400 photographs, illustrating Science, History and Art.

Professor J. Z. Gilbert was authorized to organize a Zoological Section, and the Secretary was instructed to communicate with Mrs. Erskine M. Ross, and request from her an allotment in her Rancho La Brea for excavation under the auspices of this Academy, in a search for fossil and geological specimens.

The Publication Committee was instructed to issue a Bulletin in July.

Mr. P. D. Barnhart and Rev. E. Stanton Hodgin were elected members of the Academy.

Board adjourned.

On June 28, 1909, in Room 625, San Fernando Building, a Zoological Section of this Academy was organized by William A. Spalding, George W. Parsons, Professor J. Z. Gilbert, William H. Knight and Holdridge O. Collins.

Prof. Gilbert was elected Chairman and William H. Knight, Secretary, but Mr. Knight resigning, Mr. Parsons was chosen Secretary.

A meeting of the Section was held at the residence of Mr. S. J. Keese on Monday, June 12, 1909, at which Prof. Gilbert gave a statement of the progress in the excavations at the Rancho La Brea, made immediatedly possible by means of the generous donation to the Section by Mr. John D. Hooker. He placed upon exhibition several fossils, in an excellent condition of preservation, of long-extinct animals, which he had excavated at this place, and he outlined the plan for future work under the auspices of the Academy.

HOLDRIDGE OZRO COLLINS,
Secretary of the Academy.

ASTRONOMICAL AND GEOLOGICAL SECTIONS.

The Astronomical and Geological Sections assembled in joint meeting on Monday, January 18, 1909, at the residence of Mr. S. J. Keese, No. 1509 Shatto street, and listened to an address by Mr. W. H. Storms, Chairman of the Geological Section, on the "Auriferous Rivers of Calaveras County, California."

This night was the sixty-first anniversary of the evening when water was turned into the tail-race or ditch constructed for Captain John A. Sutter's mill at Coloma, El Dorado County, and in which James W. Marshall found the gold nugget the next morning.

The lecture was illustrated by lantern views, and a very graphic map of the ancient gravel channels, probably formed before the advent of man. These channels, which were covered from time to time by volcanic tufa—of mud and ashes—are superimposed, one upon the other, and have been exposed at depths of hundreds of feet, by the erosion caused by the tremendous rainfalls in the early life of this planet.

The Astronomical Section assembled at 621 Witmer street, on Monday evening, February 15, 1909, and the evening was devoted to general discussion of the philosophy and scientific religious thought of Persia and India. Mr. Norton Hazeldine, who has lived in India since an infant, and is conversant with the sanscrit literature and is thoroughly familiar with the systems of the various religious bodies of the Orient, explained the intimate association of most of the Eastern religions with scientific principles, more particularly as relates to Astronomy and Chemistry.

A very large number of ladies and gentlemen assembled in the apartments of Col. Eddy in Hillcrest for the March meeting of the Astronomical Section. The subject for consideration was "Life in other Worlds."

Mr. Knight, Chairman of the Section, conducted the meeting. An extended discussion prevailed as to the conditions for life in other planets, but the expressions of thought were not confined entirely to this channel, and diverged to the line of biology and a mixture of theological argument as to the origin of all life. The presentation of the subject by the materialist, the agnostic, and the theologian caused this meeting to be one of the most interesting and agreeable of the season.

HOLDRIDGE OZRO COLLINS,
Secretary of the Astronomical Section.

Statement of Condition *of*

First National Bank

Los Angeles, California

At Close of Business, June 23, 1909

RESOURCES

Loans and Discounts		$10,985,041.64
Bonds, Securities, Etc.		2,508,930.00
Cash and Sight Exchange		5,169,501.49
Total		$18,663,473.13

LIABILITIES

Capital Stock		$ 1,250,000.00
Surplus and Undivided Profits		1,697,296.30
Circulating Notes Secured by U.S. Bonds	$1,250,000.00	
Less Amount on Hand and in Treasury for Redemption or in Transit	580,602.50	
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Deposits		15,064,779.33
Total		$18,663,473.13

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Southern California Academy of Sciences

VOLUME IX

Table of Contents and Index

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1910

Contents of Volume IX

Index to Volume IX

BULLETIN

OF THE

Southern California Academy of Sciences

LOS ANGELES, CALIFORNIA, U. S. A.

JANUARY, 1910

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BULLETIN

OF THE

Southern California Academy of Sciences

COMMITTEE ON PUBLICATION:

Holdridge Ozro Collins, LL. D., Chairman.
Anstruther Davidson, C. M., M. D. Frank D. Bullard, M. D.

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CONTENTS:

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ROOM 625 SAN FERNANDO BUILDING

Southern California Academy of Sciences

Officers and Directors, 1909-1910

WILLIAM A. SPALDING .... President
WILLIAM H. KNIGHT .... First Vice-President
JOHN D. HOOKER .... Second Vice-President
SAMUEL J. KEESE .... Treasurer
HOLDRIDGE OZRO COLLINS .... Secretary

Bernhard R. Baumgardt	George W. Parsons
Frank D. Bullard	William L. Watts
Anstruther Davidson	Clement A. Whiting

Sections of the Academy

Astronomical Section

William H. Knight, Chairman — Holdridge O. Collins, Secretary

Geological Section

W. H. Storms, Chairman — G. Major Taber, Secretary

Biological Section

Clement A. Whiting, Chairman — C. H. Phinney, Secretary

Zoological Section

James Z. Gilbert, Chairman — George W. Parsons, Secretary

Botanical Section

Anstruther Davidson, Chairman

The Lake of Asphaltum and Water and the Old Hancock Home, Rancho la Brea.
Courtesy of Sunset Magazine.

Editorial

The article in this number of the Bulletin, by Professor James Z. Gilbert, Chairman of our Zoological Section, will be received with absorbing interest, not only by members of the Academy, but by all Scientific Institutions which receive our publications.

The wonderful deposit in La Brea Rancho of fossils of extinct fauna of the Pacific Coast has attracted the attention of zoologists throughout the whole extent of America, and so great has been the desire to secure specimens from this field, that the most noted Scientific Bodies in the land, from the Smithsonian Institution, through the long list down to the small College, have applied for permission to excavate in this unique store of treasure.

Mrs. Erskine M. Ross, the owner of the Rancho, imbued with the local patriotism of our Native Sons and Daughters, and thoroughly appreciating the value of these discoveries as illustrating the history of this region before the advent of man, has refused to allow these remains to be taken from California, and by her direction only this Academy of Sciences, the State University and the Los Angeles High School will be custodians of these fossils. This, as well, for the education of our youth, and the study by all interested in the geology and zoology of this State, as a memorial to Major Hancock, one of the earliest American settlers, and progressive citizens of Los Angeles.

In the early Spanish adobe life of Los Angeles, when lumber was an impossible factor, the roofs of the buildings were covered with a natural waterproof material, called Brea, composed of the dried or hardened mixture of asphaltum and sand or gravel. Upon the Rancho of Major Hancock, but a few miles from the city, were large deposits of this Brea, surrounding springs of water, side by side with the continual and bountiful flowing asphaltum. From this place most of the roofing material of the city was taken, and gradually a little lake was formed by the excavations, composed of water and asphaltum, through which the natural gas of the underworld

APR 29 1910

forced its way, giving the place somewhat the resemblance of a boiling pot. Today the visitor stands with wonder on the bank of this little sheet of water, as he listens to the constant bursting of gas bubbles, and witnesses the rings and ripples agitating its surface. The two large halftones in Professor Gilbert's article give a very fair view of this lake, and the effects of the gas issuing from its surface.

At places, in the old excavations, quantities so great, of bones were encountered that other points were selected for the work. The uninformed of those days, believed these bones to be the remains of cattle, horses and sheep which had grazed in the vicinity, and the place became known as La Huesamenta, or as we would say, "the bone yard."

In the year 1901, Professor W. W. Orcutt, now the manager of the Geological and Land Department of the Union Oil Company of California, while examining the geological conditions relating to the occurrence of petroleum on La Brea Rancho, found in the asphaltum beds a quantity of bones, some of which were of ordinary appearance, but others were so massive that they excited his curiosity. He made only a cursory examination at that time, but in the summer of 1902 he took from the brea bed a Saber of the Saber-tooth Tiger, and soon after he excavated the skull of a young Saber-tooth Tiger, the skull of a Wolf, teeth of the wild horse, fragmentary bones of Rodents, the bones or scutes from the skin of the gigantic Ground Sloth, water-worn pieces of cedar wood and several other fossils of a miscellaneous character.

These he kept in his office and exhibited to his colleagues and personal friends. In 1907 Mr. F. M. Anderson, Geologist of the Southern Pacific Company, in an examination of this collection, was so impressed with the importance of Professor Orcutt's discovery, that he informed Professor J. C. Merriam of the University of California, of the existence of these deposits. Professor Merriam immediately entered into correspondence with Professor Orcutt, which resulted in several visits to these Brea beds, and, securing permission from Mrs. Hancock, now Mrs. Ross, in the winter of 1907-8, with his assistants, he excavated several rare specimens which are now in the Zoological rooms of the State University at Berkeley; and the first public announcement of the discovery of this, the greatest deposit of its kind the world has known, was given in Professor Merriam's paper, published in the Sunset Magazine of October, 1908.

The large appropriations made by the Los Angeles City Council and the County Board of Supervisors, and the results achieved in these excavations speak louder than anything we

can say regarding the work of this Academy of Sciences, and the influence it exercises in the dissemination of scientific information throughout this community.

Our Board of Directors has entered into a contract with Los Angeles County whereby one wing of the great Historical Museum and Art Gallery, now in process of construction in Agricultural Park, will be placed under our control, and in this building will be deposited these invaluable fossils, our constantly increasing Library of over two thousand volumes, and our collections in Botany, Geology, Ichthyology, Conchology, Ethnology and Zoology, which will be freely placed before the public for examination and study.

Last summer while taking his vacation in the San Bernardino Mountains, Dr. Anstruther Davidson discovered a new species of the Mariposa Lily, one of the most beautiful of the wild flowers of California. The name Mariposa was given to this flower by the early Spanish settlers, who saw its resemblance to the wings of the butterfly in the exquisite arrangement of its variegated colors. It is found on the foothills and in the cañons of the mountains during the Spring, before the moisture has disappeared from the ground. Dr. Davidson has named his new Botanical find Calochortus paludicola, and a technical description of it is given herein.

Professor George E. Hale, Director of the Mount Wilson Solar Observatory, announces that the details of Mars are perfectly natural, with no evidence of artificial structure.

In 1877, Schiaparelli first saw the markings upon Mars, which he called **Canali**, and during the opposition of 1879 he announced not only the discovery of additional **canali**, but the strange condition of their gemination. Unfortunately, the term **canali** was translated into English as canals, when it should have been channels, rifts, gorges, or cañons, for, in 1893, he stated that "it is not necessary to suppose here the work of intelligent beings, and in spite of the almost geometric appearance of their whole system, for the present we incline to believe that they are the product of evolution of a planet."

From continued observation during the next four years, his opinions concerning these **canali** changed, and in his memoir of 1897, published by the Reale Academia del Lincei, he says: "This whole arrangement presents an indescribable simplicity and symmetry which cannot possibly be the work of chance."

Upon the announcement of Schiaparelli's discoveries, astronomers all over the world proclaimed their inability to find these markings, and they charged that Schiaparelli had been the victim of an hallucination; others, although clearly detecting these markings and even drawing them, asserted they were "illusions due to the property of light itself, the inability of the eye to maintain its mechanism of accommodation, the behavior of air waves, temporary alteration of the focus of the eye, undetected astigmatism," etc., etc., but in 1886 Perrotin and Thollon, of the Nice Observatory, emphatically confirmed the existence of these **canali**, and now they are recognized everywhere by astronomers.

Professor Percival Lowell, from his Observatory at Flagstaff, Arizona, has devoted many years to the observation and study of Mars, and Professor Schiaparelli heartily concurred in his conclusions from the results of his investigations. Professor Lowell announced that on September 30, 1905, "two striking canals became evident where no canals had ever previously been seen. The present phenomna show that the canals still are in process of creation; that we have actually seen them formed under our very eyes. The phenomena transcend any natural law, and are explicable only so far as can be seen, by the presence out yonder of animate will."

On December 29, 1909, before the British Astronomical Association, Professor E. W. Maunder, Superintendent of the Solar Department of the Royal Observatory at Greenwich, evolved the following pronunciamento: "Nobody has ever seen a single canal on Mars. There has never been any real ground for supposing that the markings on the planet supplied any evidence of artificial action. It were better for science that the canal theory be abandoned completely."

And now comes Professor Hale, who says that during the recent close opposition, his great 60-inch Reflector "showed no traces of the geometrical network of narrow 'canals' described by Lowell. The extremities of the Sabaens Sinus and the adjoining parts of the Schiaparelli 'canals,' Gihon and Haddekel, were seen to be broad and irregular, very unlike their appearance in Lowell's drawings. During the periods of best definition, when a power of 800 was required to show the smallest details, they were resolved into minute, twisted and broken filaments, not fluctuating in position, but definite and unmistakable in character. Another 'canal,' though not thus resolved, differed more markedly from Lowell's representations. Instead of continuing for a great distance as a narrow straight line, it terminated abruptly, the irregular shape of the extremity being plainly seen."

In one of his Epistles, Pope asks,

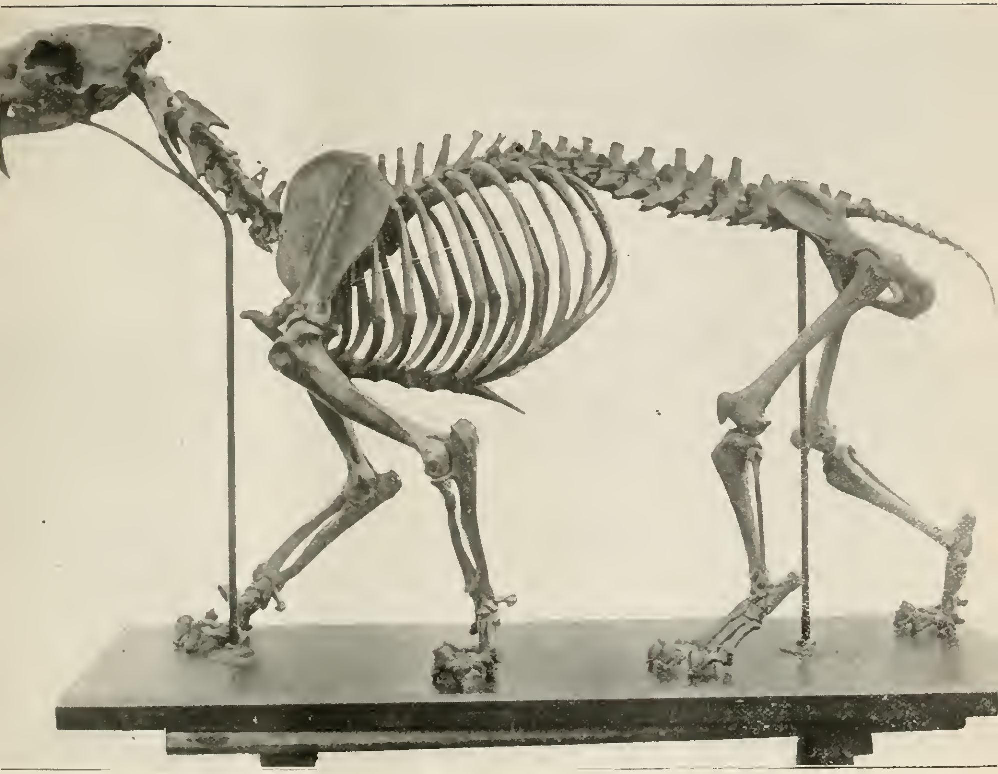
"Who shall decide, when doctors disagree,
And soundest casuists doubt, like you and me?"

A cablegram from St. Gobain, France, has brought the gratifying news that the glass disk for the 100-inch Hooker Reflector, has been successfully cast. It will start upon its long journey so soon as it can be securely packed in its iron case, and upon its arrival in Pasadena, Professor Ritchey will immediately commence its grinding, polishing and figuring with the new machinery by him devised. This labor, and the construction of the new housing and mounting upon Mount Wilson, will require about three years, and an expenditure of half a million dollars, but we can await patiently the completion of an undertaking nowhere paralleled on our globe, and such as the most vivid imagination of mankind has never heretofore conceived.

The large amount of matter in this number of the Bulletin has expanded its size so far beyond the usual dimensions that the record of the Transactions of the Academy is necessarily omitted. It will be included in the Bulletin for July.

Holdridge Ozro Collins.

MRS. ERSKINE MAYO ROSS.



Skeleton of Saber-tooth Tiger, excavated at Rancho la Brea.
Mounted by Eugene Fisher.

The Fossils of Rancho la Brea

By James Zacchaeus Gilbert.

It is not the purpose of this article to give an elaborate and exhaustive treatise of the treasures unearthed on Rancho La Brea, for this would require volumes, but to present in a brief, simple manner some of the most salient features of public interest in the work thus far done, and the finds thus far made.

In June, 1908, Mrs. Erskine M. Ross, whose photograph appears in this issue, gave to the Southern California Academy of Sciences the privilege of excavating the fossil material found upon her ranch, whereby our residents and thousands of visitors have had the opportunity to examine the most remarkable fossil bed of its kind in the world.

The Pacific Coast, geologically speaking, is a comparatively young region, and presents for investigation rare deposits of fossil material. These range from the Miocene upward, and such large exposures occur

The Lake showing ripples of the bursting gas bubbles.

on this slope of the Continent that it has come to be regarded as a very rich field for the paleontologist.

In fact, the Pacific Slope is recognized the world over as one of the very richest fields for the study of life during the geological periods. So thoroughly has the great region been studied and carefully searched that to find a deposit of such rare treasures as are entombed in the asphalt beds at Rancho La Brea, and this, too, almost within the limits of a great city, is truly a happy surprise. The more remarkable is it since the deposit area is beyond compare. The forms are unique, most thoroughly preserved, and readily accessible.

This place has been known for its "tar" more than a century, and the strange bones have been repeatedly reported locally, but the Government Survey and reports contain not a word about them. The fossils seem to have been regarded by all as the remains of ranch animals, and of the hundreds of domestic animals which have perished every year since the first Spanish missionary set foot on this virgin soil. Even so keen an observer and so careful a writer as Mr. Whitney, the State Geologist, whose report appeared in 1865, regarded these bones as being those of wild domestic animals. He describes the bony deposit as "a very large amount of asphaltum, mixed with sand and the bones of cattle and birds which have become entangled in it."

The earliest known record of this tarry deposit is that of a Spanish padre missionary, who reported it in his notes of exploration in 1769. He mentions in his diary the tar and the use of it for calking of canoes, and for roofing purposes. Little attention was paid to this deposit, except that the natives and the settlers used it for fuel, roofing and paving. The roofs of the first adobe houses built in Los Angeles were covered with asphalt from La Brea springs. From that early day until 1863 there is little mention of the Brea beds.

A large area of some 5000 acres was owned by several Spanish grantees, from whom the land was purchased by Major Hancock, the title subsequently being perfected by Senator Cole of Washington, who afterward came into possession of a thousand acres of this land around the present site of Colegrove. Major Hancock in 1853 made a second survey of Los Angeles, known as the Hancock survey. After the Civil War the development of the asphaltum deposits on the Rancho La Brea was begun. The Major developed the use of the asphalt for sidewalks and paving purposes, and shipped considerable quantities to San Francisco by schooner. This asphalt was also much used for fuel by the early Los Angeles manufacturers. It was during this Hancock development, in addition to that previously made, that the artificial lake, "The Pit," was formed by removing large quantities of asphaltum.

In 1883 Major Hancock died, leaving his wife with her little family of three to bear the misfortunes of widowhood. In her sorrow for loss of companionship, her anxiety on account of the perplexities of large financial plans, she left the city and sought the quietude of a home on the ranch. Here she reared her little ones to lives of honor, and even now, the buildings, nestled among the trees by the side of the pool of such marvelous treasures, are suggestive of peace and quietude, industry and thrift.

With a more luxuriant vegetable growth, a more semi-tropic climate, a more abundant rainfall and perchance a slightly lower altitude, this place was the scene of those bygone days when animals, prodigies in size, vast in numbers, great in variety and remarkable in development, lost their lives and left their bones to rest through past ages in the tarry springs.

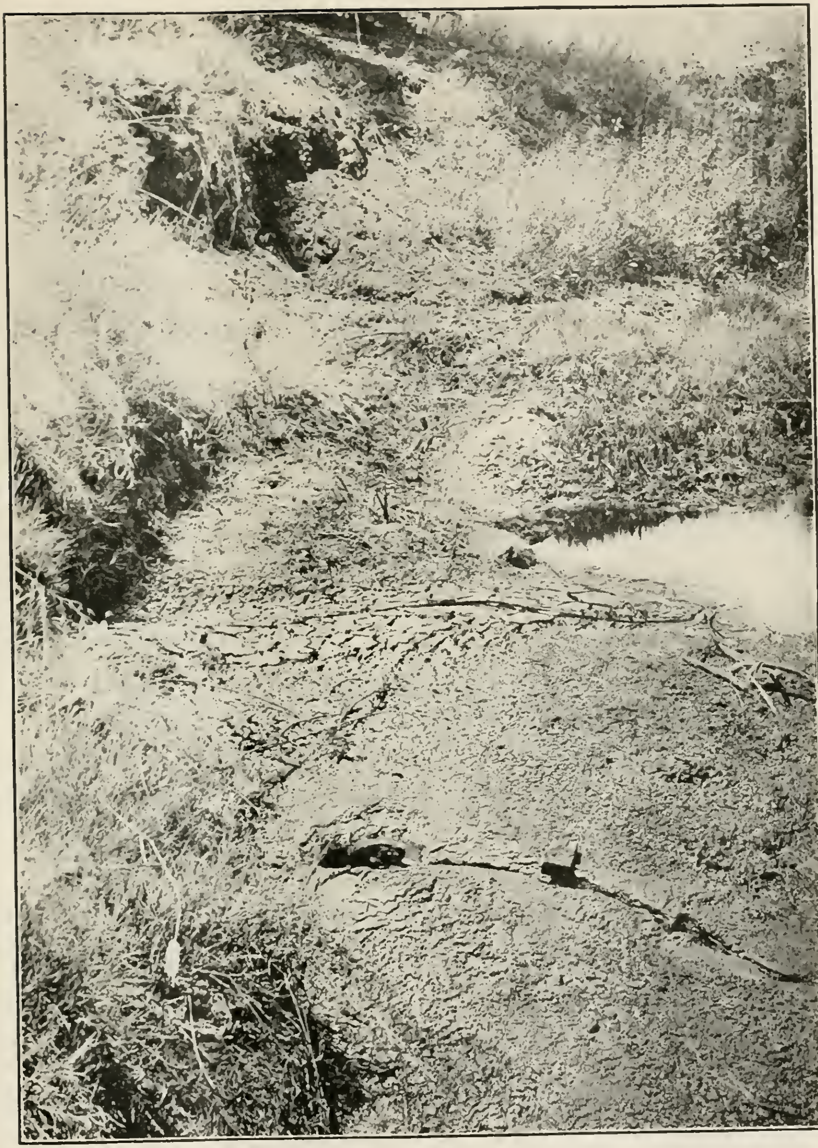
A Lecture on Zoology in "the Pit."

In 1875 Mr. Wm. Denton received from Major Hancock one of the very large sabers of the Saber-tooth tiger. Thus the Major was doubtless the first one to observe the peculiarity of these bones, and recognize them as belonging to extinct forms.

On further inquiry the writer learned that Mr. W. W. Orcutt, secretary of the Union Oil Company, was the first geologist to consider the bones of this deposit as being really prehistoric.

The deposit on Rancho La Brea has been variously styled La Brea Beds; The Death Trap; The Fossil Gardens; The Asphalt Beds; The Bone Field; The Pit; Rancho La Brea Beds; Rancho La Brea Formation; La Brea Pleistocene Beds; La Brea Pleistocene Formation, etc., intended to designate the deposit of bones in the tarry pits on the Hancock ranch. All these designations, each suggesting an element which should be in the name, lack very essential particulars. A name should include reference to the greatest deposit of its kind, the location, and due credit to any person directly concerned in its discovery. In view of these three essentials, and by the consent of the owner of these deposits, I have used the name, The Hancock Brea Deposits.

Up to date the most extensive explorations have been carried on by the Southern California Academy of Sciences. This Academy, wholly in the interest of free educational advantages for public good, has secured a very great quantity of most excellent material, which forms the chief subject-matter of this article, and the results of its labors will be placed before the public in the large and convenient Museum now in process of construction.



Two active Asphaltum Springs in a corner of "the Pit."

According to Geological Reports, this deposit is well designated as Pleistocene, or early Quaternary, and a portion of the great Elysian Park anticline. From this anticline there extends a special formation

of a divergent subordinate fold along the fracture line or axis of which the escape of gases occurs. The general trend of this axis is nearly east and west in the region of the deposit, which is bounded on the north by the Santa Monica Hills, and on the south by another gently rising anticline. It dips so abruptly southward into the productive area of oil just north of the brea beds, that at less than two miles to the south of the field no well-paying oil sand has been found, even at a depth of 5320 feet.

The various changes in elevation of the Pacific Coast have produced changes in the conditions of erosion and deposition, resulting in an environment more or less favorable to the development of plant and animal life. Evidences are abundant to show that at one time in the history of the southwest this area was lower and more marshy; the climate was milder, the rainfall more abundant, vegetation more luxuriant, giving rise to a correspondingly highly developed fauna, and support to a greater variety of forms. This semi-tropical condition was succeeded by a rise of the land, the fall of temperature, and the "ice age" or glacial epoch was ushered in. The snow and ice extended far to the south, especially in the higher altitudes, and gave the death chill to the life of the pre-glacial or Pleistocene time.

It was at this time, about two hundred thousand years ago, that the plants and animals of Rancho La Brea perished and were buried. The subsequent sinking of the land resulting in the change of rainfall and temperature, brought about the melting of the ice, and introducing the present age. The slighter subsequent changes of level, both local and general, have caused many local disturbances, and it is suggested that the breaking and scattering of the bones in the Brea deposit have been due to such causes, but this is without evidence in the beds themselves. In fact, the general miring of animals and the scattering of their bones by carnivores, and the drifting by water, followed by the natural settling of the deposit in such accumulations, are quite sufficient to account for all changes noted.

The very remarkable number of vents through which the gas is constantly escaping all over this area in and around the Brea deposits, suggests the probability of another line of fracture, composed of numerous disconnected minor direct and reverse faults, extending southwest from the subordinate flexure, and, just as the fault zone along the line of the sudden dip, referred to above, marks the northern boundary line of the richest productive area, so the abundant escape of gases along the line of the Brea beds suggests another line of fracture which may reach the southern limit of the productive field. Strength is given to this idea by the logs of the wells in the area south of the beds, which show oil seeps at various depths, but in no paying quantities. The failure of the deepest well to find a profitable basin of oil sand indicates broken strata filled with joint cracks, giving rise to slight displacements and tiny fissures. If this surmise be substantiated, then there is little hope of finding much oil south of the Brea deposit region. The Tar Springs have formed no insignificant part in the role for the accumulation of oil, tar and water throughout the whole mass of material. Thus as the materials were forced upward by great pressure, the gas carried the oil, tar and water with it. This mixture impregnated the previous beds of formations, making local oil and tar lakes, until finally in the upward course, reaching the top of the vent, tar springs and lakes naturally occurred on the surface. The bursting gas bubbles left tar-lined cavities of varying dimensions, which soon became filled with water, and the seeping oil saturated the ground, rendering the subsoil quite soft and sticky.

The consistency of this tar varies from a light miry liquid to a very heavy almost solid, immovable mass, which on drying becomes so flint-like as to turn the points of a pick. The condition varies much with the change in temperature, hence specimens in the bank which would be removed with difficulty in the morning, when heated by the noon-day sun would fall out. The springs too, become more active in the summer season, and in the afternoon of each day. At the time of greatest activity the bubbles are smaller and more frequent, while at other times larger and more massive.

The "stick-tu-at-iveness" of this material is evident from what has been said, and those who work in the beds understand it perfectly, for the clothing becomes covered with tar, and layer upon layer improves the durability of the garments so much that a second pair of shoes is not needed. Then, too, there is no need for rubber boots nor leggings for the penetrating tar fills the fabric, rendering it perfectly impervious to water. This sticky mass prevents water from entering the pit, though the digging is now about ten feet below the level of the lake. The penetrative power of this asphalt-bearing oil is so great that there is not a substance, clay, sand, wood, or bone within several feet of the spring that is not thoroughly impregnated with the tar; and it slowly oozes from the long bones for weeks, if they are not opened and cleaned or thoroughly soaked in coal oil and rinsed in gasoline.

The surface layers of varying thickness from the pure glistening tar to the hard asphalt pavement, are formed by the evaporation of the volatile ingredients. These, in connection with the dust and drifting sands carried by the winds, make a deceptive covering for the spring, causing it to appear firm and strong. The quantity of water in the cavities, or the scanty "salt grass" which grows around these springs are quite tempting to a thirsty or starving animal. The bait is thus placed and the trap is set.

It is thus easy to see how an animal wandering in the twilight in search for food and drink would in the extremity of famine be driven to partake of the last lingering remnants of food. When once the feet begin to sink into the sticky mass, while quenching the burning thirst or satisfying the gnawing hunger, they could not be withdrawn, and hence while the animal would try to release one foot the other would be forced downward the farther. Deeper and deeper until limb and body, neck and head are completely submerged, or perchance in the struggle only the nostrils are closed with the tarry mass and death by suffocation ensues, or it may be from sheer exhaustion the animal yields to the inevitable and groaning, sinks to the ground limp and dying. Again, it doubtless occurred that an animal caught, either cried for help or out of distress, and thus attracted the preying beasts. It was then that a horrible feast followed when the lion, the tiger, the wolf and coyote, alike trained to the piteous cries hastened to the scene to satiate their appetites while the killing was being done. The tiger drank the blood; the lion quickly found the great deep muscles, the wolves and coyotes were content with the smaller parts, and quickly the unfortunate creature was torn asunder from limb to lung and scattered in every direction. Judging from the way the bones of the same skeleton are distributed in the deposits the parts which would otherwise have stood upright in the mire, were pulled from the tar and greedily devoured. The many gnawed bones suggest the great scarcity of food, while the interlocked jaws and broken teeth and scarred skulls tell most vividly of the frightful struggles which went on.

The Mastodon and Saber-tooth Tiger of the Quaternary Age.

On one occasion two skulls were found with the jaws interlocked and the teeth broken at the place of contact as though the animals, both victor and vanquished in the fiercest of the strife died together. In this way the feast was constantly renewed. With the nightly feast completed and the participants remaining behind, or in safe retreat to the mountain fastnesses or in the neighboring jungles, the day would bring another group to the ready meal. The condors, hawks, eagles and vultures, larger and more fierce than those of today would gather here and feed to the full their rapacious desire. These, too, though generally cautious, would be at times off guard and unmindful of the treacherous tar, they would sink a foot, or dip a wing, or touch the tail and add another specimen to earth's museum and record another witness of the life that once lived here, but could not survive.

There is one other way in which some bones came to be in these chimney-like holes of deposits and that is by drifting in from the plains in flood time. These carried along by shallow water would be readily caught on the tarry masses which accumulated around the springs then covered with drifting sand during drouth and impregnated with oil.

These pools of tar when not strewn with debris or covered with dust and sand but fresh with the flow, appear in the twilight or the shadow of night most remarkably like water and give the same reflection from the mirror-like surface. The deception is perfect and almost daily, insects, snakes, birds, mice skunks, rabbits, etc., are being caught. On one occasion a skunk started along a smooth dust path across a circular area, but it had proceeded only about three feet from the edge when further progress was impossible. The surface was soft, the feet stuck fast and in a day or two only the white tip of its tail remained above to tell of the fatal event. Another night scene is illustrated by Figure 1. A beautiful burrowing owl

Figure 1.

lured by the glassy surface of a pleasant pool, dropped into the water as it supposed the liquid to be, for a drink, but alas the wretched deceit. With fastened feet and outspread wings, a sinking breast and a buried beak, the struggling bird perished. Another event evinces the deceptive appearance of these tarry places. This is shown in the pathetic picture of a swallow whose, "skimming-the-brink" instinct urged it in the shadowy evening to try the shining pool. No sooner did its downward sweep strike the oil than the wings both tipped, the tail dragged and not a limb could be moved. And in Figure 2 we see it on its bier.

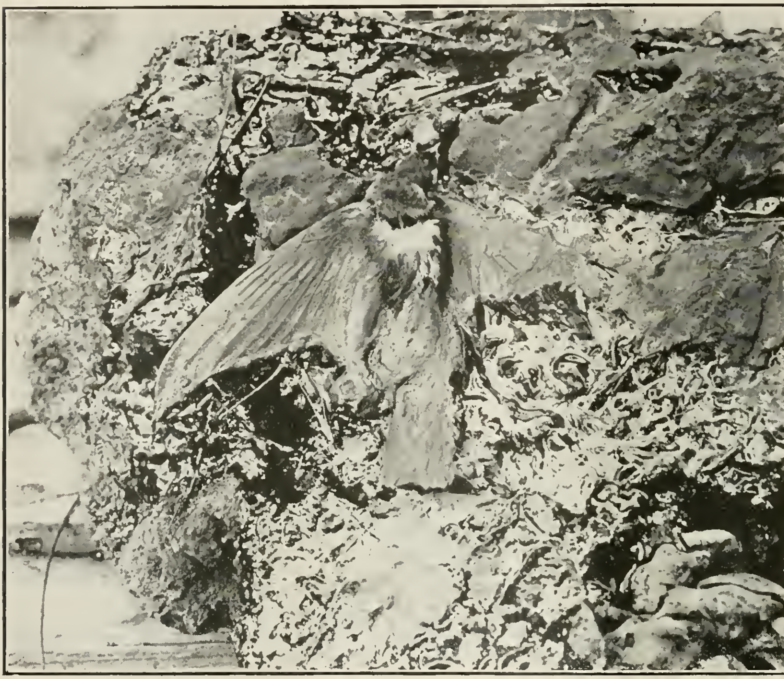


Figure 2.

One day when showing some visitors the field, a black looking snake came slowly along my path. I stopped in wonder at its queer movements. On examination I found its eyes were completely closed with the tar and its body covered. It proved to be a king-snake and was so emaciated by starvation and weakened from exhaustion, that it lay on my hand perfectly still. Another, a gopher snake, was found badly smeared with tar which being removed by a bath in coal oil and gasoline, the poor creature was set free. Numberless instances could be cited, but space forbids. Suffice to say, that a linnet, a lark, a crane, a duck, a squirrel and many others were found just caught or dying, decaying or leaving only traces of the whitened bones bleaching in the hot summer sun.

According to the record of the ranch managers and the neighbors, the trapping of barnyard animals is no uncommon circumstance. On one occasion a fine horse of three years, frightened by a passing automobile rushed across the field and ran unwittingly into one of these tar pools. When the owner discovered it, it had sunk to half way up its sides in the mire. All efforts to extricate the beast were in vain until a traction engine, passing by at the critical moment, was pressed into service. With a rope around the horse's neck, and with a long steady pull the animal was rescued, but it was not until with great labor and patience in applying gasoline that the colt was made respectable.

As these skeletons were deposited from year to year during the centuries, thousands doubtless wasted away and appear only as decayed animal matter, while others, thoroughly preserved by the tar, remain to the present almost as perfect as recent bones. These fossils are not petrifications as in most other cases elsewhere, but are the real bones, unchanged except in loss of animal matter and in their discoloration caused by the tar. This discoloring, however adds to, rather than detracts from their beauty, for when polished they shine like the best of old bronze.

The fossil vegetable forms also suffered the same fate and appear

Fossil Cypress.

in broken fragments of leaves, twigs, limbs and trunks of trees as well as of seeds and cones. These all appear as debris and nothing is in situ. The larger amount of the material seems to be that of live-oak, cedar and pine. The species of which have not been worked out.

These bones and vegetable remains have been thrown together in such confusion as to render the removal of them very tedious and difficult. The bones are so mingled that two consecutive ones are rarely found together. But sloth and tiger, mastodon and wolf, bird and beast, in fact some part of more than twenty animals may be found in a few cubic feet of space.

To remove these, requires very little use of pick and shovel, but a great deal of painstaking labor with small tools, such as a garden trowel, flat file or a crooked wire. In this way often much less than a spoonful of the tarry matrix is removed at one time. Then too, while attempting to lift a certain desirable bone, a dozen others

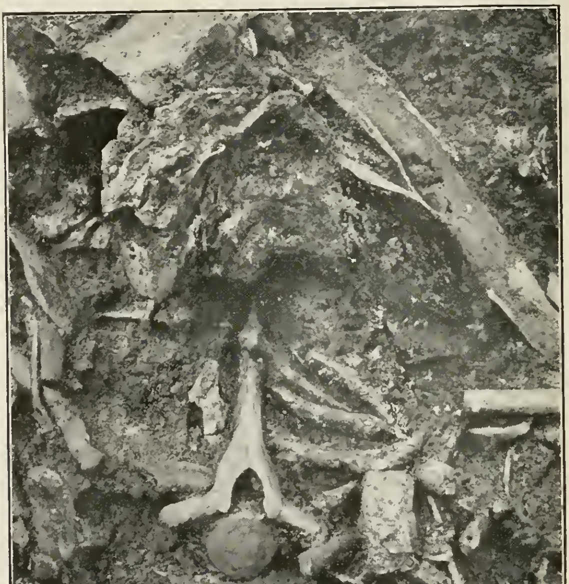


Figure 3.

crossing it in one direction and another, (Figures 3, 4) must first be most carefully taken away. This is very trying on one's patience, for it is not uncommon to begin in the morning on a certain bone and by night be, apparently farther away from it. On one occasion a member of the Board of Education came from the city to witness the digging, and decided to see a certain camel bone, plainly in sight, taken out. The digging for this bone began at 9 a. m. and it was exactly 2:30 p. m. when the coveted prize was placed in his hands.

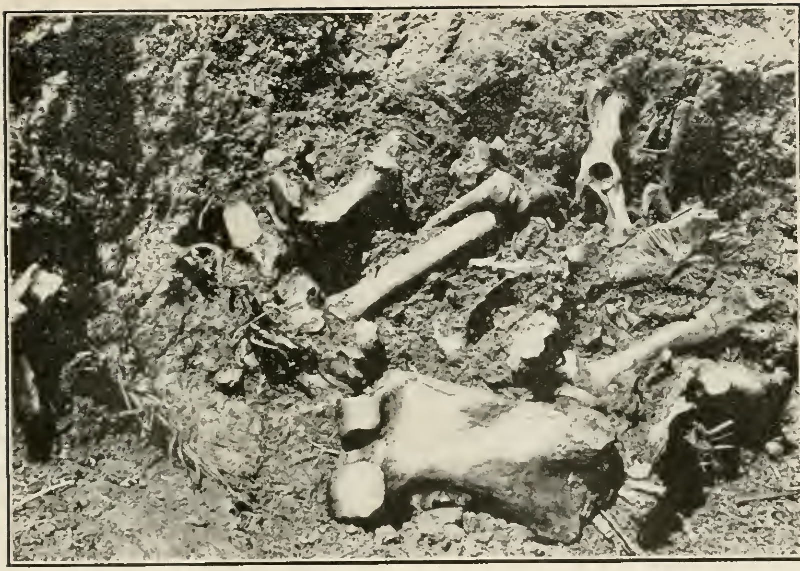


Figure 4.

While it took so long to secure the release of this one bone, there was a bushel of others taken out, which were too good to throw away and in truth probably as important as the one so eagerly sought.

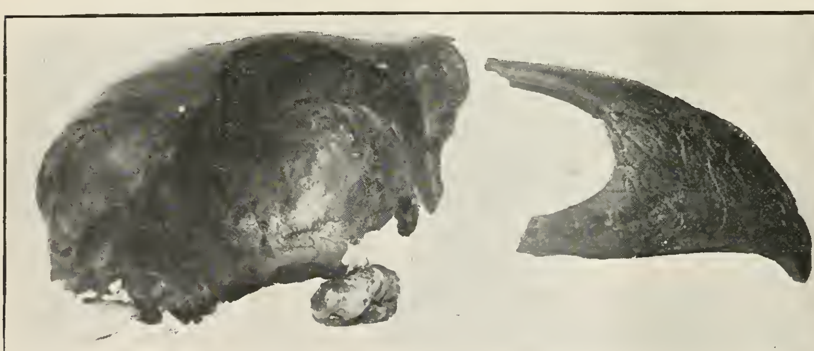
The insect life of the beds is quite meager, consisting of only a few Myriopoda and Coleoptera. In most cases only fragments remain, the antennae, mouth parts, and legs having been lost.

The only reptile represented is a turtle, of which only fragments of the Carapace have been found. The animal was small, about five inches long. Its specific identity remains to be determined later. Only one turtle was observed living in the lake upon the ranch.

That the birds should be represented in the fossil beds in great numbers is no surprise, for, when it is considered that during this period, birds of prey were numerous, they would be attracted to the remains of animals caught. The deceptiveness of the tar pools is so perfect, that birds of today are caught just as in ages past. Meadow larks, herons, bitterns, hawks, etc., are caught every season in great numbers. The skeletons are very incomplete, and the merest traces of small passerines are found. This last fact, however, is explainable on the ground of there being no attraction in the pools for them, and the few that might wander here might have been devoured, or have been destroyed in the motion of the tar, due to rising bubbles. Their bodies being small, they would not be caught except in the softest tar. The list of birds thus far identified includes the turkey vulture, golden eagle, western black vulture, California condor, raven, red tailed hawk, marsh hawk, barn owl, long eared owl, short eared owl, great horned owl, burrowing owl, Canada goose, great blue heron,

Shanks of various extinct birds.

stork, crane, pheasant, California peacock, a new condor and teratornis merriami. That peacocks should be found here, is remarkable since this bird is known only in the old world. There are doubtless several species of these, as the material at hand shows a decided difference in structure. The teratornis named by Mr. Miller is the very largest bird thus far determined. It was larger than any of our present condors and was a large sailing bird with a strongly compressed, hooked beak and very deep.



Skull and Beak of California Teratornis.

The birds evidently survived the ordeal of extinction suffered by the mammals, since so many of the forms found are yet living. This is what might be expected, since the birds are more readily capable of migration, and the amount of their food required is comparatively small. A glance at the list reveals the great preponderance of the flesh eaters, which is to be expected, since so many chances were offered to feed upon the dead carcasses of the mammals, caught

Skull and Beak of extinct California Condor.

in the tarry beds. Some of these birds while eating would, themselves, in one way and another be caught in the tar, only to become food for those following them. The scattered bones of these birds were preserved in the narrower springs, which in the accumulation year by year, resulted in chimney-like deposits with layer upon layer.

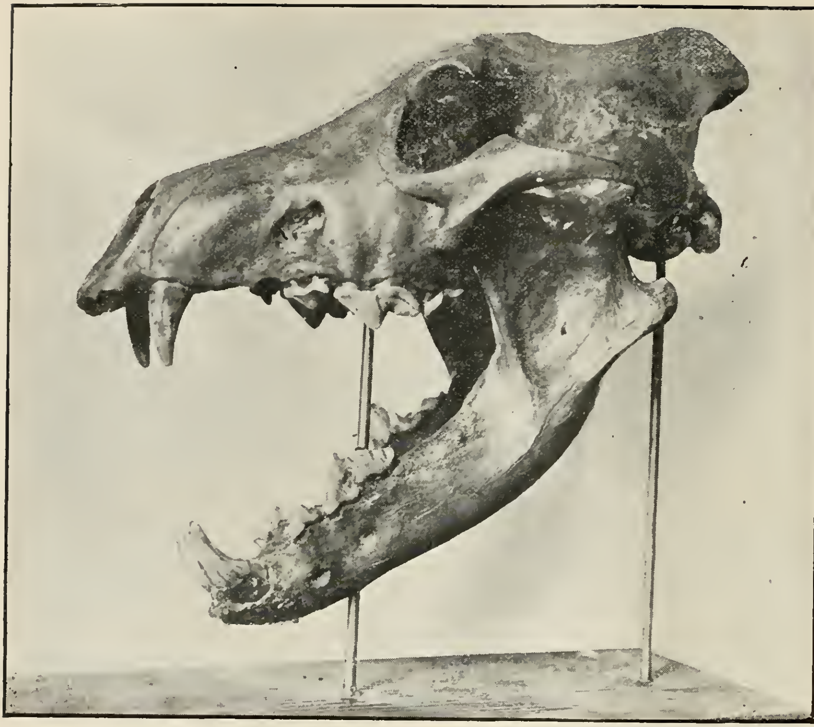
In spite of the fact of the survival of many forms, quite a number of the species became extinct in the crisis of unfavorable circumstances. The cause of extinction was doubtless that resulting in the death of the mammals, race decay and starvation. Just as species of birds are fading from the earth now, so then, the animals upon which these large raptores fed perished and they also disappeared.

Whence came the peacock? This bird, closely related to the turkey, seems to have appeared first in the rocks of India, whence ages ago it began to spread westward, reaching parts of Europe, north through Asia and east along China and Japan. Crossing the Behring land bridge it came down our coast in time to appear here in our beds in early Quaternary times. Other finds elsewhere are anxiously awaited, for the migration of the peacock looks strongly toward Asiatic origin. It must be held in mind however that migration was in those days possible toward Asia from here, as was the case with the camel.

If numbers found count for determining the dominant type, the golden eagle was by far most numerous, followed by the black vulture and turkey buzzard, alike plentiful, and the California condor making about 10 per cent of the whole, while the largest bird of all, was rather rare being about 5 per cent.

Among the mammals represented in the beds, the carnivores greatly outnumber all others. Judging from the individual skulls found, 75 per cent are carnivores of which 66 per cent are saber-tooth tigers, 20 per cent are wolves, 5 per cent coyotes 4 per cent lions, 2 per cent fox and the remainder other forms.

Of the herbivores, 45 per cent are giant ground sloth, 20 the American ox, 12 the horse, 10 the mastodon, 5 the camel and the remainder, traces of elephant, deer, etc.



American Giant Wolf. Canis occidentalis.

The canine group is represented by the wolf, two species, the coyote, the fox and the domestic dog. The coyote and wolf are extinct, but the fox is quite likely our living gray species. The great wolf was an exceedingly large one, even excelling our largest living specimens. Judging from the strength of the bones it must have been more clumsy and less fleet than our coyotes. Of this wolf, little has heretofore been found, except a few teeth which were discovered in Indiana and Texas. Here in the brea beds the bones are numerous. Sufficient numbers have been unearthed to complete several entire skeletons.

The smaller species, much fewer in number, are close relatives of our timber wolf of which there are probably only varieties.

The coyote is new, but it may have been ancestral to our present form. The fox was a very small one and was perhaps the individual ancestor of our present-day gray fox, or maybe only a variety of the same species.

The dog family, like the cat family has had a very wide distribution. It is found in every part of the world, as well as in fossil forms.

The fossil remains antedate man by several geologic ages, and are distributed in every continent. South America has no representative true wolves except the Falkland Island wolf, and, since the fossil forms are very recent, the dog family must have come down from the north over our country and wandered to the southern extremity of the new world. On their way a few were caught in the tar and died. Since the dogs of Australia have left fossil remains, there they certainly must have migrated from Asia, while strange enough, one extinct dog of South America resembles in the parts of the skull our domestic dogs and is especially allied to our coyote.

Teeth of Llama, Horse, Giant Wolf, Camel, Sloth, Lion, Saber and Milk Saber of Saber-tooth Tiger.

One of our fossil wolves is identified as canis indianensis, the Indian wolf of Arabia. This fact gives us a very striking incident of migration and contemporaneous development. Southeastern Asia is regarded as the original home of the family, and to find in Arabia the same species as we dig up here in our beds is indeed remarkable. The migration westward, landed them in Arabia and northeastward, into our continent by way of the Behring Strait. That these two branches should have retained their identity through the centuries and through such varied conditions as were found in this long migration, is astonishing.

Perhaps the very most remarkable group of animals found in the brea beds is that of the cats. The representatives found here are the great American lion and the saber-tooth tigers. The former is remarkable for its rarity, while the latter is wonderful in its abundance. In the collection so far made, more than fifty per cent of the mammal individuals are the tigers.

To date as many as fifty individuals have been represented by skulls and other parts. In every digging their bones are found, and eight skulls beside many other bones were excavated in one single cubic yard of earth. This tiger is the chief representative of a group of the cat family in which the upper canine teeth have shown a tendency to elongation, and of all cats of all times and of all places, this one was the strongest and most highly specialized. This specialization is in the sabers which extend below the jaw in some cases as much as seven inches. These canines develop through many generations into long thin, strongly recurved, saber-like teeth, with a sharp cutting edge fore and aft. Figure 5.

Figure 5.

The cat family presents three great groups in its past history and each group has its saber-tooth, but in none did the development proceed so far as in the true cats where our marvelous form of the Brea occurs. The earliest known cats appear in the Eocene of France, while in America they appear first in the Miocene of Nebraska and Colorado. Following these, were the false saber-tooths of middle and upper Miocene of Oregon, one of which was about the size of a panther and had a saber, but this was very weak and thin laterally and lacked the serrated edges.

The next showing progress, was a small cat called dinicis cyclops about the size of a Canada lynx and it had a saber-tooth long enough to reach to the inferior surface of the lower jaw, but instead of passing downward outside the lower jaw, it pressed down into a deep socket, specially developed to receive it.

Then came a small cat, found in Oregon, having a saber the shape and size of a shark's tooth, flat, broad at the base, serrated and coming quickly to a point. This was doubtless deciduous, as are the milk canines of our specimen, Figure 6. Another from this region

Figure 6.

of which only a skull is known, was a tiger-like cat approaching the size of our living types, and presented a saber which passed outside of the lower jaw as in ours, but the sabers were not nearly so long, reaching only to the inferior surface of the mandibles, while in ours they reach as much as three inches below.

Another species presents a more powerful saber-tooth, but with no increased strength of the claws and limbs. Following this was a cat about the size of the red lynx, which had keen cutting edged canines, and strongly compressed. After this series of types the true cats appear in the middle Miocene of Europe and later in the upper Miocene of North America. By following foreign forms a gradual development is seen in the saber teeth, from that in the last false cat to that of the Pleistocene Saber-tooth tigers of Rancho La Brea. These foreign forms show a gradual lengthening, increased lateral compression, and, first one edge serrated, then both, until the final climax is reached in the very remarkable beast of our finds.

Skull of Saber-tooth Tiger.

The use of the sabers has been a standing puzzle and all manner of uses have been assigned them, from holding to the ice flows, to the climbing of trees. One suggests instruments of defense by a downward thrust, another as prehensile organs in capturing food and tearing the flesh into shreds, but the most probable use was that of stabbing its prey. These cats were not fish eaters and hence could not have developed these teeth in the way the walrus developed its tusks, and the remarkable claws present, would suffice for clinging; and, judging from its size, this animal likely lived upon the ground and sprang upön its victim from that position. It would seem as a means of defense since it was the largest of its kind, that such sabers were unnecessary, and also as its great claws would be formidable weapons against attack from wolves, coyotes, etc. It being in comparative peace with the lion, it had no fears from that source so long as there was plenty of vegetable eaters about, and the herbivores would of course give no trouble. It would therefore seem that there was no occasion to bring these teeth into play as means of defense.

These would appear clumsy indeed in ordinary chewing, or tearing of food and it has been urged that it could not have opened its mouth wide enough to admit a large piece of flesh.

A careful study of the anatomy of the skull of this animal, made first by Dr. W. D. Matthews of the American Museum, concluded that these teeth were used as stabbing organs, and this view is readily suggested by every skull in the collections made. The coronoid process is so small as to be almost wanting, which fact in connection with a shallow glenoid fossa, gives great freedom of motion to the mandibles. This freedom of motion may have allowed the lower jaw to drop down and back against the neck, while the sabers were being used for stabbing in the powerful downward stroke of the head. Figure 5. Judging from the spaces about the skull for muscles and muscular attachment, this animal must have had a powerful neck and could have sunk the sabers to their full depth of six inches into the flesh of any animal. With these considerations it is not difficult to see how a capture of prey might have been made. With a single leap this tiger could be upon the back of the largest mastodon, and, holding on securely by the great claws, could sink the sabers, and with a backward rip cause a long gaping wound which would supply a copious flow of blood. Then closing the mouth, the blood could be drunk or lapped at will.

Surrounded with such great beasts as the mastodon, elephant, giant ground sloth, etc., such feasts could be common, to say nothing of the great amount of flesh thus made ready for other animals.

Little wonder then, that when one of these huge beasts sought a drink in the tar beds, and his feet became fastened in the sticky mass, that he was an easy prey for one of the fierce tigers. Among the methods of capture of the cat tribe, one especially is of interest here. It is the habit of animals to grab for the throat of its victim, and by tenaciously holding on, strangle its prey, but this hold could not be readily obtained by the saber-tooth, and though obtained, it would not be secure when attempting to use the sabers, hence another habit of leaping upon the back of its victim was employed.

The claws were greatly developed, even beyond that of the lion and these rendered his position very secure.

The above facts prove beyond doubt that this tiger was the king of beasts in its day, and was the terror and deadly foe of all in all places. Surely no other combination of structure for strength, specialization for deadly work, and development for dealing effective blows has ever been grouped in a single animal.

With one blow of its massive paw it could crush any ordinary foe; with a single leap it could be upon the back of the largest beast, or away from its fleetest assailant; in the struggle for mastery over food it could hold at bay any intruder, and drink at will of the hot blood, which flowed after a single stroke of its immense sabers.

Even in view of these facts it must not be taken for granted that these tigers held their proud supremacy without challenge, for the proof is quite to the contrary. neither was war waged only between the tigers and other animals. It was among themselves that the last battles were fought and the last duel finished, with death both to the victor and the vanquished.

In these beds are found a number of skulls having either one or both tusks broken away completely, or in part, and the stubs show signs of much wear. In one instance the jaws of one tiger were firmly fixed in the mouth of another, with the teeth broken at the point of contact, as though both clung to the last, even in the throes

of death. As the bones of various animals are completely mingled in the pit, this case might appear to be one of accident but for the fact that the jaws were so tightly locked and the teeth badly broken at place of contact, it seemed that nothing but a sharp conflict between the two tigers could have caused such a condition.

Many teeth are found much worn down, some broken, in fact, imperfect teeth, are the rule rather than the exception. Injuries came to the animals in those days, as well as now. This is shown by the great scar in one excavated tiger skull. This scar is about four inches long and must have been made when the tiger was comparatively young. Since the wound caused an arrested development of that side of the head, as is seen by the very much smaller canine on that side. These imperfections are further noted in the failure of development of the molar teeth in the lower jaw of an otherwise fine wolf skull, in which the molar teeth are wanting.

Disease also and malformation occur, as in the case of Exostosis in the metacarpal of the lion, Figure 7, in which not only was the

Figure 7.
Exostosis of Lion. Saber-tooth Tiger. Giant Wolf.

bone diseased but also a decided enlargement occurred in the body's effort to shut up, or heal the wound. The fusing of the bones of the lion's foot and an enlargement of pelvis occurred.

There are several causes for the extinction of animals, among which the most common are the lack of adjustment to environment

in way of food supply, ability for protection from enemies, over specialization, freedom from accident and the vitality of the race.

The factors which extend into the extinction of this species were most probably that of food supply, over specialization and accident. That the food supply became scanty is evidenced by the total extinction of the large animals upon which this species undoubtedly fed.

The saber-tooths were especially well fitted for obtaining food of a certain kind, but when this kind, the large animals, passed away they, too, disappeared. Therefore since the tigers were unable to reduce the size of the sabers to that required for effective feeding upon smaller animals, these teeth became poor instruments and when broken were worse than useless, a positive hindrance. Hence that which proved so effective under favorable conditions of a well-balanced fauna, became under unfavorable circumstances the very agent of its own destruction. Primarily therefore, over specialization was the cause of extinction.

The great American lion, Felis atrox bebbi, is one of the

Skull of a Lion.

rarest finds of the whole deposit, and from the individuals found, the tigers out-numbered it ten to one. The scarcity of these animals is further evidenced by the fact that outside of these deposits only fragments of skeletons have been known. Of these fragments a large jaw found, in 1836, near Natchez, Mississippi, seems to be the best representative. To date only five good skulls have been reported. The first discovered in October 1908, by the writer, the second by Dr. Bebb of Los Angeles, December 1908, and the third by Walter Price Gilbert in July 1909, the others later by the Occidental College. These skulls indicate the African type of lion in their close resemblance to that animal, but are much larger than those of any other member of the whole cat family, either recent or fossil. So far as the writer has been able to ascertain, all specimens were obtained in the lower levels of the diggings, thus indicating an earlier extinction than that of the tigers.

The fossil fragments in the beds near Natchez and this rich find at Rancho La Brea, lead us to believe that this type of lion had a very wide geographical range in our country during the Pleistocene period. The association of the great American lion and the saber-

tooth tiger in the same horizon is a surprising fact. In some respects they are much alike, yet in others radically different. They represent two quite distinct branches of the cat family, which as noted above, have come up through many, many geologic ages, having their origin in the Orient and having roamed to North America in a more recent geological time. Having their birth place somewhere in southeastern Asia, they migrated to Africa, (where the allied species now survive) to the northwest (where their remains are found, and to the northeast by way of the Behring region to our country where they became extinct.

These lions and tigers differed from each other in their race vitality. The tigers abounded in great numbers and would have survived to the present, but for the specialization of their canines and the scarcity of food. It is likely, however that the tiger outlived the lion. Both became extinct in the new world approximately at the same time, but in the Orient conditions were more nearly like the original, and there the saber-tooth perished while the lions lived on and their offsprings are spread widely over the earth today.

Of the smaller animals, rabbits, rats, squirrels, badgers, gophers, coyotes and foxes are represented. These smaller forms are doubtless ancestors of our present forms, except the coyote which belonged to an extinct species.

Skull of extinct Coyote.

It is but natural that these smaller animals should survive since they would not require the great amount of food as would the larger ones, and they could easily hide away and make their own retreat.

Most of these animals are supposed to have originated in the north. Though the United States is regarded as the home of the skunks and badgers. The skunks, though now spread over northern North America, and south and west over the United States, Central America and Guatemala, are regarded as originating in the Sonoran region, and in their migration came to California, and some left their record in the Brea Beds. The American badgers range well into the north, but are regarded as Sonoran in origin. Thus these two came west and leaving some remains in Rancho La Brea, survived with the country, and are now digging holes in the banks of the very pits in which their fated ancestors died.

The chief herbivores represented in the Brea Beds are the deer, antelope, American ox, camel, American horse, giant ground sloth, elephant and mastodon.

That such a large group of gigantic animals should be found to have roamed over our country is very remarkable, and at first was greatly doubted, yet the evidences are unmistakable, for their remains are actually secured from the tarry graves and the identity cannot be denied.

Splint bones of extinct Giant Horse

Among the many species found, the ancient horse has contributed its share to the general subject of wonders. The specimens are fragments of horse both young and old, taken from the beds at a depth ranging from five to twenty feet. The greater number of individuals is either young or old, which is due to the inexperience of the young and the inability of the old. The specimens of dentition are either so immature, or are so worn with age that a satisfactory identification has thus far been quite difficult and doubtful. The material thus far obtained being quite fragmentary, specific identification has not been attempted. This scarcity of middle-aged forms is in harmony with reports from farmers in other parts of California, where the stock is caught in the local springs. The ranchmen report only young colts and very feeble animals among those caught. The young are easily frightened, and it is easy to understand how the sudden appearance of a saber-tooth in the midst of a herd would cause a stampede, which would likely result in one or more of these rushing into the pools of tar. This done, the result of one more fossil was inevitable.

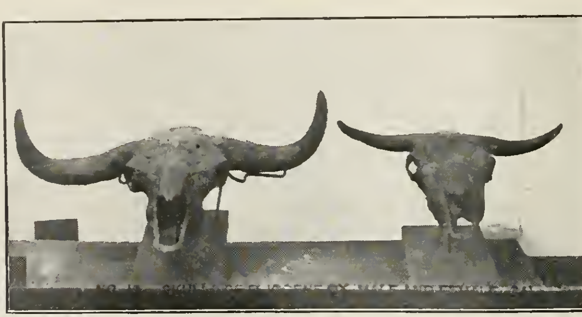
While the horses found in our beds were the single-toed ones, yet they are not to be considered in any way related to the living horses, or those found running wild over the plains of Texas and the pampas of South America. These were doubtless of Spanish introduction.

Our fossil forms were the last remnant of that very remarkable race of horses found first in the United States. The real ancestor of the horses found in the London clays of Europe was an animal about the size of a fox. Very shortly after, this find was duplicated in the discovery of the same form in the Eocene Beds of the United States. These animals had four toes in front and three behind, while a still earlier ancestor called Phanaeodus had in each foot five toes. It was from this little animal of the Tertiaries, that through the subsequent ages longer and longer bones having fewer and fewer toes appeared. Thus from age to age, the horse developed in size and lost in toes until we see the very singular animal of the fossil in the Brea Beds, a large, strong, but single-toed animal walking upon the end of the toe nail of the middle digit. America seems to be the original home of the horse, although the find is duplicated

in Europe in as early a horizon as here. If our correlations of horizons is correct, several problems are suggested, among which, whether Europe and America were once a common land area, or did the horse have a dual origin and thus gave rise to these similar forms, or after all was there only one place of origin, and migration took place at a date yet unknown? If only one, then which,—the United States or Europe,—is to be regarded as the home?

Figure 8.

Among the large forms that attract the visitors at the Brea Beds is that of an immense ox, Bos antiquus. The family to which this species belongs is the Bovidae characterized by hollow horns, hence what we find fossil are only the horn cores. Of the five specimens found, one is particularly large and likely a mature male, Figure 8, while the others are younger females, Figure 9b. The ox



a. b.

Figure 9.

differs from the cow in its more convex and broader forehead, in the great size of the horn cores, which suddenly drop below the level of the occiput, and in the proportionately smaller teeth. The one figured in situ, Figure 9b, is the first find of the Academy. It is doubtless the skull of a female and measures thirty-one inches between the horn core tips. Enough material has been found to restore this skeleton entire. They are not represented in large numbers, and yet in comparing the size and habits of the species with that of others there must have been a great many in the country. The distribution of the American ox was wide over the whole northern hemisphere. The bison, which forms a distinct group of the genus Bos is characteristic of North America, although the Bos Americanus (living) ranges far down into the United States. The European bison in addition to spreading all over Europe in Pleistocene times, wandered to Arctic America. This group wandered still farther and one species was found in the Pleistocene of Texas in 1846. It was likely the progenitor of the recent species of this country. Peculiarly, this last has a very near relative in the Pliocene formation of the Siwalik Hills of India. It is further remarkable that none of these forms are found as yet determined in the Brea Beds, but another old World form, the ancient ox (B. antiquus), is our find.

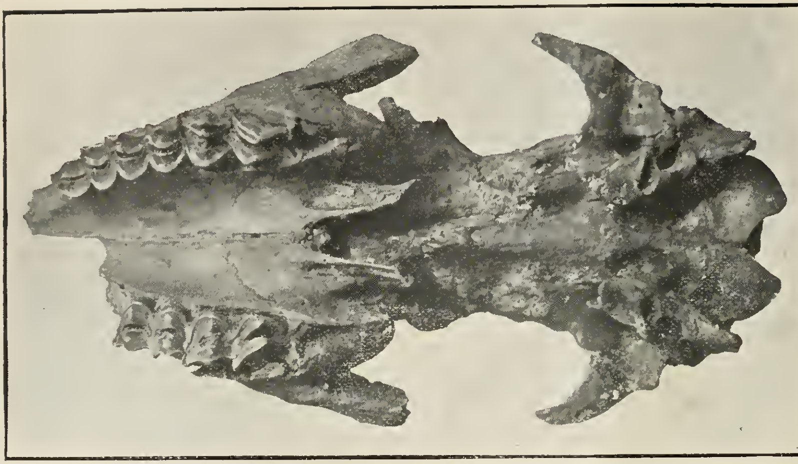
This species was no doubt, quite numerous, and attained to an enormous size, much larger than any living forms. A generalized type of the antelope (called Protragoceros) marks the first appearance of the hollow horned ruminants (Bovidae) which now affords numerous illustrations in the fauna of the old world. Thus another species flourished from the Miocene of Europe and India, spread over Asia, crossed the Behring bridge and then passed away, while the more hardy bison of our plains have survived.

To find camel material in our diggings was a happy surprise. Other large animals had been represented in fair numbers and to add the ancient camel to the long list was a pleasure, indeed.

Of this animal only an imperfect skull and several limb bones have so far been unearthed. For the living forms, (although none are now wild) our minds revert to the Orient and it is scarcely believable that they once strode over this country, yet this is true, as is evidenced by this and other finds which have been made heretofore, at other places.

Of the camel (Camelidae) family we have living representatives in the camels of Asia and Africa and the Vicunas guanacos and llamas of South America. Fossil camels occur in the Pliocene of India and the Pleistocene of Algeria, while a host of extinct genera more or less closely allied to the living South America forms, occurs in the Tertiary deposits of the United States.

It is interesting to note that, since in Argentine and Brazil, remains of the llama and the related types occur only in the more recent of Monte Hermosa and Pampean and cavern deposits; these South America species evidently were comparatively recent immigrants to that region from North America. The fact, too, that the fossil remains are found no lower in India and Europe than the Pliocene, makes it certain that they migrated from Asia to the west into Algeria, appearing there in time to be fossilized in the Pleistocene beds. While the fossil remains are so scarce and so narrowly confined in the old world, it is quite the reverse in the new. In North America, camel remains range from the Pleistocene down to the lower Oligocene and with a geographical distribution that is as wide as the continent. From the living form downward we meet with such types as Plauchenia, Procamelus, Protolabis to the very small generalized animal of the



Skull of young Camel.

middle Oligocene called Proebrotherium, which in turn was preceeded in the lower or Unita Oligocene by a representative called Lepto tragulus, which itself may have sprung from a still earlier form, the Homacodon of the Bridger (earlier Eocene) beds.

It is quite evident that the camels of today came in rather direct line from more generalized forms and were originally a North American group. Hence when the camel lay down and died in the Brea Beds, it was buried in its native country. From this favored spot the earliest forms began their long process of differentiation and migration of the earth. That the molar dentition of the Siwalik camels is very similar to that of the vicunas and guanacos of South America is remarkable, and a common branch must appear somewhere in the genetic tree. Why this species (having peculiar molar teeth) should become extinct in India, but develop and survive in South America, is likewise a problem. What native tendency or habit or climatic conditions or character of food should, in two such widely separated regions, give rise to the dentition, and in the one fade away, and in the other survive, are queries that remain unanswered. In fact, the disappearance of the camels from North America is very strange indeed, yet not more singular and perplexing than the disappearance of this whole great group of other large animals represented in the Brea Beds.

On the whole then, we have here a very remarkable illustration of world-wide migration, beginning in the United States in the lower Eocene (Uintocene Oligocene) beds. From here the distribution was rapid over the Mississippi valley with one branch, (llamas) turning southward, and probably by the way of the Isthmus of Panama, entered the South American continent in the Post-pleistocene times, to be spread over the whole region and subsequently to survive in the sheltering Andes. The other branch (Camelus) pushed to the

Figure 10.

northward during the time of a more seasonable climate than now exists, crossed Behring Strait into the old world in the Pliocene times: Thence the march was southward into India, westward into Algeria and gave rise, with modifications to the present camels of those regions.

Among the curious animals found in the fossil gardens of Brea Rancho, none are more odd and at the same time more plentiful, than the giant ground sloth. This animal is now nowhere known and only very distant relatives are found in the tree sloths. ant-eaters and armadillos of South America. The number of individuals represented in the beds is quite great. The skulls and limb-bones are met with more often than those of any other large herbivorous animals. Sufficient have been found to build a complete skeleton. The skull, Figure 10, is a very perfect specimen and a very large one. It was a well-matured animal as shown by the teeth which were badly worn. One other is less robust, but is an inch larger. The skull of a baby sloth, found next its mother, is shown in Figure 11. The humerus is of a mature individual, and presents very remarkable developments of prominences and concavaties for muscular attachment, which indicate, in connection with the strength of the bone, a very heavy, strong-built animal.

The femur shows less irregularity, as is generally the case, but is very much stouter than the humerus. This, in connection with the immense pelvis, Figure 12, which measures 42 inches from ilium to ilium, and the other hindleg bones, proves the animal to have been built somewhat after the fashion of a kangaroo, (although in no way related to it) having a light pectoral girdle and limbs, and a

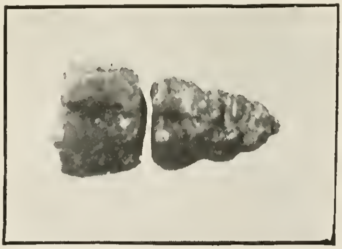
Figure 11.

Figure 12.

very heavy pelvic girdle and limbs. In addition to this there was a very stout tail, sufficiently strong to form with the hind legs, a tripod upon which to stand while reaching into the trees for leaves and tender twigs. Judging from the skeleton, this animal must have measured as much as 22 or 25 feet from tip to tip. Its weight was perhaps that of a large ox. The strong peg-like teeth are set some distance from each other in the jaws. These occur only as cheek teeth there being no incisors. The absence of these gives them the name Edentates, meaning without teeth.

The last joint of each toe is tipped with a very sharp, curved claw instead of a hoof, as was suspected, judging from the flat teeth. The claws in front were doubtless used for reaching into the trees for food, and for digging roots. In this way the animal was so amply able to defend itself as to render a successful attack from an enemy almost impossible. Especially was this true since the pebble-like bones (called scutes) imbedded in the skin made it almost impenetrable. Little was known about the character of the sloth skin until ten or twelve years ago, when a well preserved piece of dried skin was found, having on the outside a growth of coarse hair and pebble-like bones imbedded within the skin. The discovery, made by Dr. F. P. Moreno of Chili.-Argentine Boundary Commission, at Last Hope Inlet, in Patagonia, solved the mystery, and led to the search of a cave near by, where were found other remains, which pointed undoubtedly to the ground sloth as the real possessor of the skin. Dr. A. Smith Woodward of the British Museum, after a careful study of this piece of skin, showed that it had come from the ground sloth. It is interesting to note that this peculiar beast of our beds was covered with scanty coarse hair, resembling on the one hand the living tree sloth of South America, and on the other hand, by the dermal, pebble-like bones (scutes), the bony armor of the armadillos of the same region.

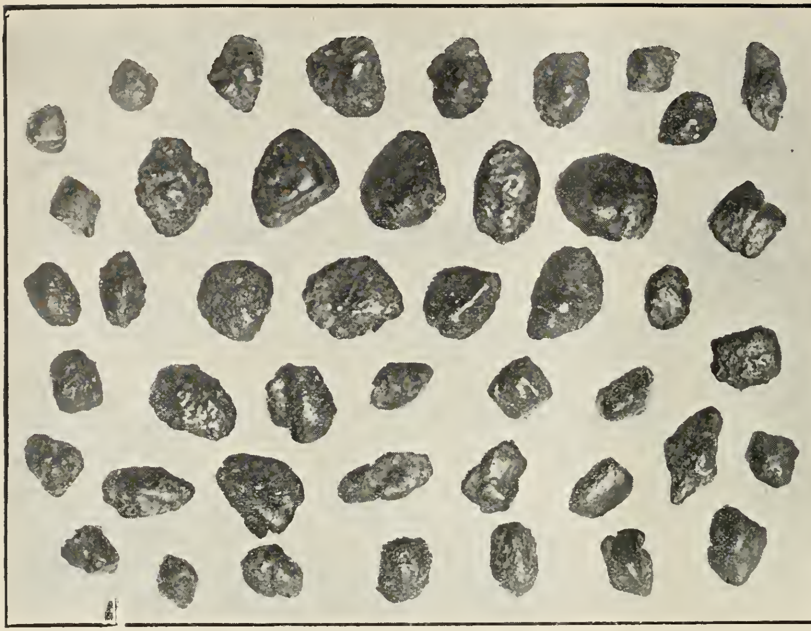
Skin of Giant Ground Sloth.



Caudal vertebrae of Giant Ground Sloth.

How this skin, discovered in Patagonia, was so well preserved through the thousands of years is yet unknown. Many pounds of these scutes have been found in the Brea beds, and Dr. J. C. Merriam reports a very interesting find of a section of asphalt containing a shoulder blade of the ground sloth with a layer of pebble bones over it. This fine illustration of the remarkable armor is on exhibition in the Museum at Berkeley.

While excavating, the writer found on several occasions several patches four or five inches square covered with these scutes. One piece was of much larger size. Some of the scutes were very close together, others were almost an inch apart. Being related to the living armadillos and sloths, our fossil form must have had some ancestors



Dermal Scutes of the Giant Sloth.

which would show the connection. In this we are not disappointed, for in examining the fossils of South America, there was found a very large strange animal, protected by a skin development of an almost complete bony armor, which formed a solid coat of mail. This differed from that of the armadillos in that the carapace of the latter was not a solid shield, but the bucklers in front and behind were connected by a number of movable, overlapping bands, which in some cases admitted the rolling of the animal up into a ball. But this giant Glyptodont, as it is called, walked around carrying its immense armor very much after the fashion of a great tortoise. This shield must have been very heavy, and doubtless had something to do with causing this animal to have very stout limbs. In other species this armor was beautifully ornamented, and all was surmounted by a heavy horny covering. The next animal had the armor made of plates arranged in rows separate from each other upon the sides of the body and the tail, had isolated bony tissues filled in between with smaller scutes. Strange enough it is that another fossil should be found in South America, a relative of the armadillos, which had plates, the outer surface of which was smooth, each being perforated with three or four large holes for the passage of blood vessels; which fact would indicate that the whole was invested with a continuous leathery skin. Thus the bony plates would be buried beneath the skin, or within it, just as in our giant ground sloth. One more species was found, one of this kind, a very little creature only two feet long, which had incipient movable bands in the margins of the middle region of the carapace, which remarkable fact

marks this small form as the common ancestor of the living armadillos and the armored glyptodonts, and in the size is found the resemblance to the ground sloths.

The giant ground sloth resembles living sloths in the shape of the skull and dentition, while in the limb bones they resemble the anteaters. The sloths of the Brea Beds therefore had their origin in the Santa Cruz beds of Argentine, from which place they spread over South America and wandered in Miocene times to North America, where they appear in the Pliocene and Pleistocene formations. Thy roamed as far north as Nebraska, east to Virginia, and west to the Brea Beds of California, and the caves along the coast. By the time they arrived here, they had grown to such enormous size as our specimens (Moroteriun). and the armor had become reduced to mere scutes scattered here and there throughout the skin.

The only probable successful enemy of the sloth was doubtless the saber-tooth tiger, which would leap upon the back of this sluggish beast and with a stab and a rip backwards, would lay open the flesh and drink the copious flow of blood. Thus one by one, reduced by sudden death and longer starvation, the most peculiar of all our wanderers to the Brea Beds became extinct.

Where these came from to South America is not known, but if we regard the Pangolins and Aardvarks of the old world and the fossil specimens of doubtful affinity of France as related, then it is probable that our forms came from the Old World by way of an Antarctic continent.

It was in 1797 that our sagacious and philosophic President Thomas Jefferson found the first material, the claw bones of this sloth in a

Ribbons from an Asphaltum Spring.

Figure 13.

cave in Virginia, and named it Megalonyx, judging, since the animal had claws, that it was carnivorous. Later Dr. Harlan found some bones in the Big Bone Cave of Tennessee, and named them as a new species, but the true identity of the animal was not known until the remains were found in the caves of Patagonia. Here it was plain that the peg-like teeth of Tennessee and the claws of Virginia belonged to the same species. Thus was solved the mystery of carnivor-like claws, herbivor-like teeth and an armadillo-like skin all combined in one animal. So fresh seemed the material of the Patagonian caves, that an expedition was sent out to find, if possible, a living specimen, but as might have been expected, to no purpose. They had disappeared long, long before.

The mastodon is the largest fossil obtained on Rancho La Brea. It may be readily recognized by the cheek teeth, Figures 13, 14, in which the crowns rise in three to five low, transverse ridges separated

Figure 14.

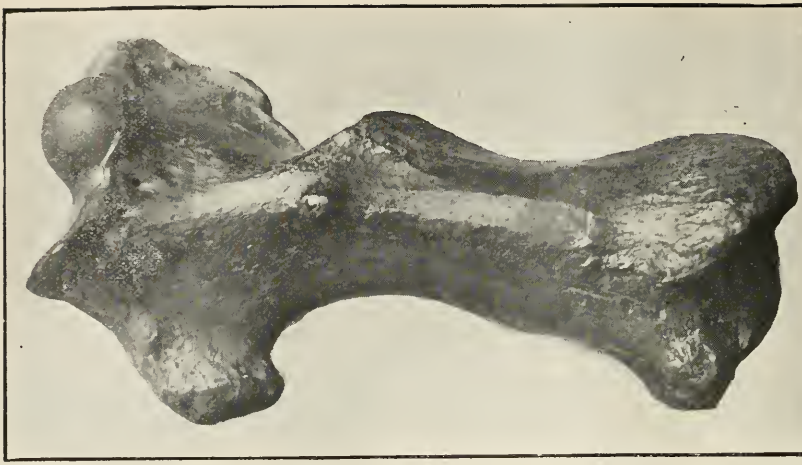


Figure 15.

into more or less distinct tubercles, with the tips merely pointed or irregularly cupped. Figure 15 shows the humerus of a Giant Ground Sloth, undoubtedly belonging to the beast whose skull is shown in Figure 10.

The specimens figured are of two individuals. The femur is from a mature and a larger animal, the remainder of which has not yet been found. The skull is of a young animal about two-thirds grown, however, so complete that every detail can be made out. The dentition is perfect, large and massive, and presents a beautiful, dark glossy luster. The tusks were represented only by short portions which were four inches in diameter, while the whole was probably four feet long.

During the excavation of these remains no little excitement prevailed about the place, as scores of wonderstruck and admiring visitors daily came to see the skull of the largest group of animal that ever stalked our valleys and drank at our springs. Good skulls are few in the United States, although fragmentary ones have been found in great numbers. These huge beasts which weighed more than our present elephants, were widely distributed over North America, appearing so far as known, in the greater numbers in the Mississippi Valley, being especially abundant in New York, Ohio and Kentucky. The earliest finds were made in New York, and were described as human bones of great giants. To identify such bones as being those of man, affords an illustration of the wild desire to find human remains associated with all animals.

The elephant is represented in the beds by only a tooth and possibly by a few bones, enough however to prove their presence here. The other specimen of a tooth figured in connection with the dentition of the mastodon, was obtained by Mr. Homer Hamlin at Inglewood in the excavations of the outfall sewer, fifty feet below the surface. It is not through the direct relationship of this species, Elephas Columbi that the line of descent is traced, but through another species of North America, which is equivalent to E. Primogenus of Europe, which in turn is closely allied to the elephants of India

(E. indicus). Both of these doubtless originated from a common stock, from the Siwalik Hills of India, E. hysudricus. Since traces of the mammoth are also found, it is interesting to note the origin in southeastern Asia and to contemplate their migration to the north into Siberia, to the west into Europe, to the southwest into Africa and to the northeast along the Asiatic coast, across the Behring Channel, and thence in every direction over Aferica. It is again interesting to learn that the living elephants of India and Africa have sprung from the mastodon of India, yet they were confined to India and only their nearly related progeny spread out over the world. The elephants commenced their more recent history in the Pliocene time in India and thence spread through northern Africa and Europe during Pleistocene times.

The elephants of India and Africa are the living representatives of the group of largest land forms known to history. This group is characterized by the presence of proboscis from which these ungulates are named Proboscidea. Of this group the family Elephantidea includes three genera, elephants, mastodons and mammoths. The elephants are readily recognized by their cheek teeth which have the form of more or less elevated parallel plates filled in between with cement. There is a species of elephant, a Pliocene fossil of Asia, which presents teeth with plates comparatively low, numerous and with little cement filling. This therefore stands as a connecting link between ancient mastodons and the elephants of today.

The elephant has forty-four teeth, eleven in each half of each jaw. While there are rarely more than this number, yet it is in cases greatly reduced—even to zero as in the ant-bears where the jaws are toothless. Since the individual grinders are greatly enlarged, and all others are lost save two grinders in each half jaw, and the second pair of incisors above, the number seems to be reduced to six in the elephant. The real number is greater than this. The tooth begins its growth in the rear of each jaw and gradually moves forward, (as shown by Sir Richard Owen) in the arc of a circle gradually replacing the preceding one as it wears away by use, until finally this older tooth is shoved from the jaw and the new one is in full service. Owen's dental formula for the modern elephant is given thus: Incisors, $\frac{2-2}{0-0}$ Molars, $\frac{6-6}{6-6}$ which means that there are two tusks in each upper jaw, the milk set being replaced by the permanent one, and the lower jaw wanting in these which in one of the fossil forms of mastodon are present. This formula further means that there are altogether six grinders in each jaw, the first milk teeth appearing at the age of two weeks and shed at two years.

The second is shed at six years, the third at nine, the fourth at twenty to twenty-five, the fifth at sixty and the sixth lasts the remainder of the creature's life, at least to the age of 100 or 120 years. With this data of Prof. Owen's in mind, it is intensely interesting to examine the dentitions of a young mastodon in which the full milk dentition of three well-formed cheek teeth is present, with the remarkable fact of the first permanent tooth just cutting the gums from below and behind the third milk grinders. Thus if the cutting of teeth of the modern elephant can be taken as fairly typical of the same process in mastodons, then the specimen is of a young mastodon, less than nine years of age. What a baby! A pathetic scene must have occurred here, for the remains of both the mother and the baby were found not over ten feet apart in the beds. The mother seemed farther on and in from the bank than

Molars of Mastodon Americanus. Eliphas columbi, Eliphas primogenus, Eliphas imperator.

the baby. The mother may have ventured to drink at the tarry pool, or perhaps to eat of the scanty vegetation near it: But the treachery of the sticky subsoil proved to be a fatal trap, both for herself and her baby.

Right lower jaw of young mastodon, showing cutting of first permanent tooth.

The tusks of the elephant grow continually throughout life, hence do not become very hard and resistant, but soon decay. This fact accounts for the poor condition in which most of the tusks are found.

While the exact origin of the greath North American true elephant is quite perplexing, yet one thing seems evident, that they came from the Orient by way of Behring bridge. Three species occur here—E. imperator and E. columbi and E. primogenus. The first two of these roamed over the country together, from east to west, from north to south as far as Mexico. Only a single specimen tooth E. imperator having been reported from the lower Pleistocene of French Guiana. The evolutionary process of the Probiscidia began in Fayum, Egypt, with a form about three feet tall with only a slight protrusion of the upper lip for a proboscis and no upper tusks, but with the lower incisors extending forward. It is from the undeveloped and generalized form that the mastodons and elephants of Europe, Asia and America came. Thus began in Egypt one of the most remarkable race histories known to mankind and continued to the present and might persist as long as time shall last, but for the ravages of man.

From the foregoing it must be clear that, without exception, all the animals buried in the asphalt beds on Rancho La Brea were wanderers thither. Some from other parts of North America as their native home, while others had compassed the earth to arrive here. What a scattering of life in its instinct to roam: What an effort

to persist in the progeny of the races, and what a changed view of earth's fauna, is presented in the survey of the hidden treasures of these tar beds. The light thus far shed is pleasing and intensely interesting, yet as the more intense the light the deeper the darkness, so here the night of unsolved mysteries is only deepened. Whence, why and how these diverse forms, this enormous size, these varied degrees of activity, these original types, how these peculiar instincts, this rise of intelligence, this differentiation, the nicety of adaptation, the dwarfing and decay. What movements of earth, what changes of environment, what great catastrophe or relentless hand has caused this apparent extinction so sudden and complete.

Evolutionary changes of Proboscidia
Smithsonian Institution Report, 1908.

The student of geology sees in his mind a picture vastly different from the recent conditions and living fauna as he looks upon the strange forms of sloth, camel, ox, elephant, lion, tiger, etc. Nothing but a semi-tropical clime could have supported these gigantic animals, and their presence carries the mind across the water to Africa and India for duplicate life. Here the mastodon roamed from place to place, the American ox grazed on the plains, the giant sloth reached into the trees for the tender leaves and twigs, the stalking camels wended their way to the scanty watering places, the horse with its colt wandered peacefully among them. The hungry wolf, the giant tiger and the king of beasts, with their howl and snarl and roar

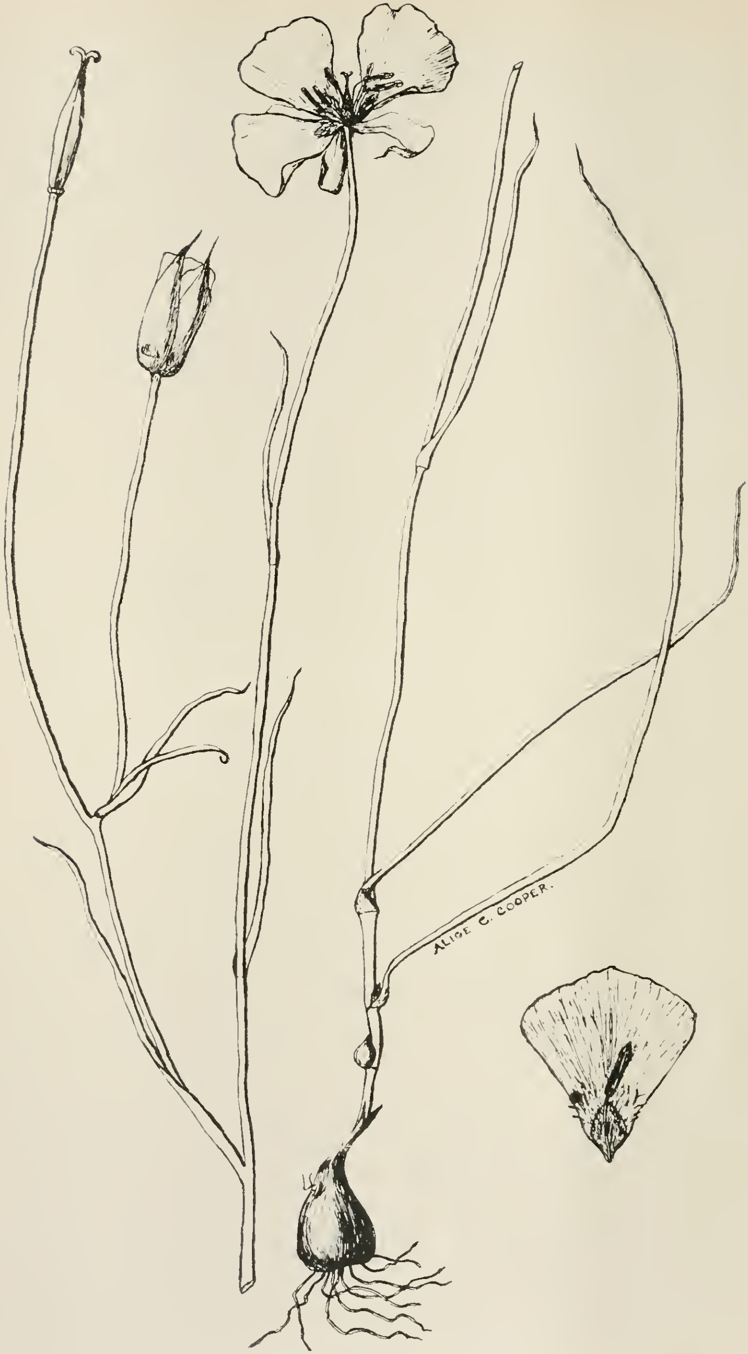
made hideous the night, while the sailing condor, the soaring eagle and the swooping hawk and birds of song made lively the air the livelong day. What happened to disturb this daily hum of animal life no tongue can tell, and only the vivid imagination of man can conjecture. The coast gradually rose to a higher level, the mountain spurs reached down to the sea and cut off the passage to the north and south, while the deserts of the east and the waters of the west prevented the escape. The drouth occasioned by the rise of the land and consequent decrease of water supply, resulted in scanty vegetation and scarcity of water. The large animals could not survive the drouth, hence one after another, year after year passed away. Many of these in their search for food and water found their grave in the tar pools and left their record there. The beasts of prey found each struggling victim a ready source for food, they themselves now and again, falling a helpless prey to those that followed. The great feathered tribe, not slow to see an opportunity, flew down and partook of a ready meal. These, too, striving here in their eagerness for food, would lose their balance, touch a foot, dip a wing, or drop a tail into the tarry mass, until they, in their turn became record-makers in the world's history.

Nature, relentless and implacable, swerves not from her steadied course and yields no fixed law. Thus passed away a fauna as remarkable as it was abundant; and apparently as suddenly as a catastrophe and as completely as a total extinction.

The age to which the Brea deposits have been referred is early Quatenary, Pleistocene. The whole region has been a flood plain of deposition during which time the accumulation of fossils took place. Subsequently a gradual rise in the land occurred, resulting in making the region a plain of erosion, which it is today. This erosion uncovered the deposits to such an extent that the prehistoric bones are found from the surface down, as far as the digging has reached, (22 feet). No continuous record of fauna from the Pleistocene to the present has yet been found; on the other hand a sudden break occurs at the very surface and in the deposits yet covered with the layers of soil above and all specimens seem to belong to one group of a single time.

One interesting evidence lending support to the idea that this deposit is Pleistocene and that too probably the early (lower), is the presence of the Imperial elephant (E. imperator), which Prof. Richard S. Lull has said "appeared in the lower Pleistocene (Equus of Sheridan beds)". Although this tooth was found in the lower level of the diggings, yet other finds must be made and a better correlation of the Pleistocene deposits in general must be worked out before the exact location (lower, higher, or middle) in the Pleistocene can be determined.

Three of the specimens figured in this paper were not obtained by the writer. The elephant tooth, (E. primogenus) found on San Miguel Island, was loaned by Prof W. A. Fisk of Occidental College. The mastodon jaw (M. Americanum) and the elephant tooth (E. columbi) were found near Inglewood in the diggings of the outfall sewer, and were loaned by Mr. Homer Hamlin, Los Angeles. The back portion of a skull (Teratornis californiens) from the Brea beds was loaned by Prof. L. H. Miller of Los Angeles State Normal School. My thanks are due to these gentlemen for their kindness.



Calochortus paludicola.—Davidson.

Calochortus paludicola n. sp.

Anstruther Davidson, M. D.

Corm membraneously coated; stem light green, slender, upright, bulbiferous at base, 4-6 dm. high; basal leaves 2 or 3, the lowest 1.5-2 dm. long, 4-5 mm. wide; folded; stem leaves 2-3 linear, 2.5-5 cm. long; flowers 2-4 never umbellate, 3.5-5 cm. wide, in full anthesis somewhat rotate, sepals oblong, lanceolate, acute, recurved 1.5 cm. long, one margin broadly scarious at base the other less so, internally yellowish with conspicuous oblong brown spots; petals rose colored to pale pink, obovate 2.5 cm. long, rounded above, occasionally prominent but never apiculate, claw purplish brown, triangular in outline 3 mm. wide by 5 mm. long, scattering yellow hairs on lower third of petals, filament and ovary light brown, anthers obtuse, white or pinkish, 5 mm. long slightly shorter than filament. Capsule 5 cm. long tapering at each end.

Meadows Bear Valley, San Bernardino Mts., 6500 ft. alt., July, 1909. No. 2171, Davidson-type.

Common in the semi-moist edges of the streams and meadows bordering the southern side of the Bear Valley dam. Heretofore it has passed as **C. invenustus**, but it has no relation to this but is more akin to C. Palmeri. Two other Calochortii are common in this range, viz., **C. invenustus** Greene, and **C. invenustus var. montanus** Parish. Of the latter Parish remarks, "it is not a satisfactory species and may be no more than a var. of **C. invenustus.**"* Not a little of the confusion and uncertainty that characterizes much that has been written on the mariposas has arisen from the impossibility of preserving the peculiarities of the flowers in the dried state to that only the careful notes of the field student can ever determine their specific limitations.

To the author **C. invenustus** seems quite distinct from **C. splendens.** It somewhat resembles it in the narrow campanulate shape of the flower, but it differs in two important particulars. The sepals of a splendens are recurved or revolute and the inflorescence is never umbellate.

Parish has correctly transferred **C. splendens montanus** Purdy to **C. invenustus montanus** as it is obviously closely related to invenustus, rather than to splendens. I think it

*Bull. S. Cal. Acad. Vol. 1, 124.

would be more fitting to raise this variety to specific rank **C. montanus.** Mr. Parish says that invenustus is well connected by intermediates with var. montanus. In the mountains at Bear Valley these two are very distinct.

C. invenustus is abundant on the dry slopes among the live oaks and brush at Seven Oaks, at 5000 ft. alt. and was not seen at over 5500 ft. alt.

C. montanus is common on the dry slopes around Bear Valley dam at 6700 to 7000 ft. alt. The range of the two plants is here quite distinct with 2000 ft. alt. between and an examination of hundreds of them showed no intermediate forms.

On San Jacinto or other mountains it may show intermediates, as Parish says.

C. montanus lacks the green stripe on the exterior of the petals. These are darker sometimes deep purple colored with the claw yellow. If it possessed a light colored petal with a lighter colored claw than invenustus it might be considered a mere variation, but the darker petal with the lighter gland seems to negative this conclusion.

For the easier determination of herbaria specimens of the lilac colored non-oculate species, the following key may prove useful:

Flowers umbellate	
Stems bulbiferous	
Claw dark	**C. invenustus.**
Claw yellow	**C. montanus.**
Stems not bulbiferous	**C. striatus.**
Flowers not umbellate	
Stems not bulbiferous and sepals not recurved.	**C. Dunni.**
Stems bulbiferous and sepals recurved.	
Flower cup shallow, gland triangular.	**C. paludicola.**
Flower cup deep.	
Petals erose, gland small.	**C. splendens.**
Petals not erose, gland indefinite.	**C. Palmeri.**

Some Large Trees. I.

By Anstruther Davidson, M. D.

Our botanical papers and text books contain a full and accurate description of our native trees and their distribution in Southern California, but little has been written about their size or their actual measurement. Had actual measurements of our largest trees been recorded when they were first discovered, we would today have had very accurate estimate of the rate of growth and relative age of many of our forest giants. It is never too late to begin a good work and the following notes will, I hope, encourage others to search out, locate, and measure the large trees in their respective localities.

The Western Juniper (J. occidentalis) grows in scattered patches around Bear Valley dam in San Bernardino mountains. On a point on the south side of the lake about two miles from the Hotel there are a number of trees showing vigorous growth. Some of them are very large for what is described in our text books as a small tree. The tallest attain a height of 40 to 60 feet (estimated). The largest seen had a clean trunk for about 12 ft. and measured in circumference 5 ft. from the ground, 13 ft. 2 in.

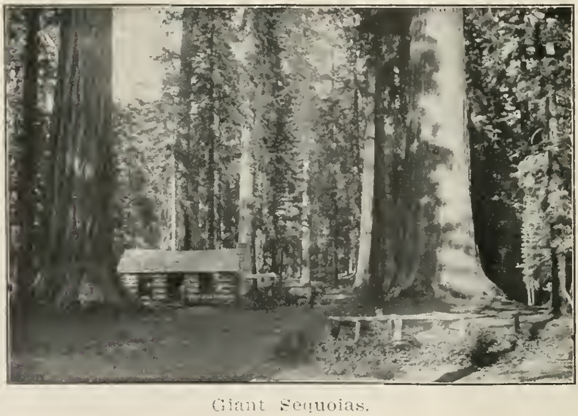
A few other large ones have branched near the base so that at 5 ft. up, there were two trunks. The largest of these, a well foliaged tree about 50 ft. high, has the two trunks measuring 12 ft. 8 in., and 10 ft. 10 in., respectively. Another similarly forked, measures 8 ft. and 13 ft. 1 in. in circumference. The Bear Valley dam is already in process of being raised 12 feet higher. When that is accomplished some of the largest trees will be submerged. Of the other trees around Bear Valley the white firs **(Abies concolor)** and yellow pines **(Pinus ponderosa)** are the largest.

Of the firs there are some splendid specimens with tall massive boles towering 100 ft. in height. The firs favor the darker and more shaded canyons and meadow margins, and naturally attain their greatest size where moisture is most easily attained. The largest I saw grows on the edge of Bluff Lake meadow. It is 22 ft. in circumference 5 ft. from the ground. At the corral at Bear Valley meadow are two firs measuring 19 ft. and 16 ft. in circumference. Another large one 15 ft. 5 in. in circumference stands on the top of the grade between Seven Oaks and Bear Valley. None of the pines there attain the circumference of the firs. The largest yellow pine stands on the edge of the stream

at the Bear Valley store and measures 21 ft. 7 in. This pine has probably attained its full growth as the top is already dead. One at the garden fence at Seven Oaks is 16 ft. The largest one at Bluff Lake among the cottages is 13 ft. 10 in. in circumference. A sugar pine midway on the trail from Seven Oaks to Bear Valley, the largest seen, measured 18 ft. 1 in. and is one of the finest trees in the district.

Judging from some estimates made on some cut stumps of pines in the neighborhood of the hotel few, if any, attain an age of 300 years, the majority dying before 200 years. The rate of growth is so closely dependent on situation and moisture that mere size is no indication of age. Of the trees examined one showed 255 annual rings, yet was only 40 in. in diameter 3 ft. from the ground. The first 45 years it grew 18 in. in diameter. The next 40 it increased 8 in. The next 40 it increased 4 in.; while the last 4 in. of growth occupied 90 years.

From the estimate made of various stumps I concluded that in this district the average growth of the yellow pine was 1 inch in diameter every 5 years till it has attained a foot in diameter, after which the average is not more than 1 inch in 10 or 12 years.



Giant Sequoias.

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A typical Southern California semi-tropical scene.

Statement of Condition *of*

First National Bank

Los Angeles, California

At Close of Business, June 23, 1909

RESOURCES

Loans and Discounts	$10,985,041.64
Bonds, Securities, Etc.	2,508,930.00
Cash and Sight Exchange	**5,169,501.49**
Total	**$18,663,473.13**

LIABILITIES

Capital Stock		$1,250,000.00
Surplus and Undivided Profits		1,697,296.30
Circulating Notes Secured by U.S. Bonds	$1,250,000.00	
Less Amount on Hand and in Treasury for Redemption or in Transit	580,602.50	
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BULLETIN

OF THE

Southern California Academy of Sciences

LOS ANGELES, CALIFORNIA, U. S. A.

JULY, 1910

The *Keese* of the Academy Observatory

A last glimpse of Halley's Comet

Vol. IX. Los Angeles, July, 1910. No. 2

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BULLETIN

OF THE

Southern California Academy of Sciences

COMMITTEE ON PUBLICATION:

Holdridge Ozro Collins, LL. D., Chairman.
Anstruther Davidson, C. M., M. D. John D. Hooker

CONTENTS:

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ROOM 625 SAN FERNANDO BUILDING

Southern California Academy of Sciences

Officers and Directors, 1910-1911

WILLIAM A. SPALDING .... President
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Editorial

HALLEY'S comet visited us on schedule time and has departed on his seventy-five years' journey to outer space far beyond the orbit of Neptune, but, unlike the sheep of little Bo-Peep, he has left his tail behind him.

The astronomer of two or three generations hence, who will watch for his advent, will read, with wonder, the story of the lost tail, and perhaps the telescopes of that day may disclose a new, minute nucleus of a planet traversing this, the greatest orbit of our system in a vain pursuit to be re-united with its parent.

What has become of this enormous aggregation of millions of miles of attenuated gases? Are they of a meagerness so sapless, that they will be dissipated in space? Will they follow, in their present condition, through eternity, the path of the comet, or will they in time,—an immeasurable time,—by the attraction of gravitation, be consolidated into another Eros, and be captured by one of our larger bodies and chained to it as a new satellite, as perhaps was the fate of the three newly discovered outer moons of Jupiter?

It is an interesting subject for thought, not only by the astronomer, but by all who study the phenomena of our System.

A few years ago, the Academy was presented with an excellent telescope. It is a refractor, equatorially mounted, with an objective of five and one-half inches, and capable of a magnifying power of 100 diameters.

Mr. Keese, who is its custodian, adjoining his residence, has constructed a lecture room which is supplied with a powerful lantern and photographic appliances, and the location, on the hills of Shatto street, affords an unobstructed view of the heavens. Mr. Keese takes pleasure in throwing open the doors to these conveniences for the meetings of the various Sections of the Academy.

JUL 27 1910

One of the most remarkable books of later days is the volume entitled "Modern Light on Immortality" by Henry Frank, Speaker for the Metropolitan Independent Church of New York City.

It is a work, as well for the Theologian whose edifice is founded upon faith, and the Scientific Materialist, who accepts nothing which cannot be proved by chemical analysis, as for the uncertain soul, troubled by the conflicting arguments for and against an alleged revealed religion.

The book is divided into two parts, the first giving a fair and candid history of the origin of the belief of an eternal, intelligent identity, after the disunion of our so-called material and spiritual parts, as taught by the Christian, the Jew, the Mohammedan and the faith of those millions of India which accepts neither a distinct hereafter-individuality nor an utter annihilation,—the Unity of a God, Emanation and Absorption and absolute happiness in Nirvana or absolute rest, of Vedaism or Buddhism.

The second part is devoted, in an equally candid way to the disclosures by modern science of the composition of the human body and its connection with the powers and functions of the soul, consciousness, or intelligence.

Those who have advocated the possibility of an endless physical existence on earth will find in this volume great satisfaction where he says, "When mankind shall have discovered the secret laws that appertain to the art of living, to Nature's own marvelous principles of life sustentation, we shall have overcome the mystery of death and shall continue to live and fructify in the no longer mortal bodies we occupy; or

That there shall be developed in some organism such a high degree of Self-Consciousness, that the physical seat in which this spiritual function resides and operates, shall be so controlled and integrated that it will be endowed with sufficient strength to continue its organic activities after this mortal coil shall have been shuffled off."

The student is left to draw his own conclusions, but there can be no doubt as to the settled ideas of Mr. Frank, when he writes as follows:

"Nowhere in the universe is there a space so minute as not to be occupied by material substance; and likewise, nowhere in the infinite is there an infinitesimal point of space or an instant of time, in which there does not inhere the principle of life.

Both matter and life being infinite, and two infinities being incapable of existing at the same time and place in mutual contradiction, matter must be a form of life, and life a form of matter." * * *

"I believe that Science will ultimately solve every problem that confronts the human mind and that to despair is to become absurd. So long as life is a phenomenon in Nature, it must be amenable to human research and its origin subject to the knowledge of man. If then, it should prove to be true that life after death is also a phenomenon in Nature, then that life, its character, evolution and history must also be amenable to human research and apprehension."

The work of cleaning and mounting the fossils from Rancho la Brea is proceeding with gratifying success, under the direction of Professor Gilbert. At this writing, a sabretooth tiger and a giant wolf stand in all the perfection of their skeleton ferocity, and bones of a giant ground sloth have been assembled, and work has been commenced on their mounting. A finely mounted and perfect skull of a sabretooth tiger, with sabres, eight inches in length, has been placed in the office of the Secretary where it can be seen at any time by members of the Academy and their friends.

Holdridge Ozro Collins.

Additions and Corrections to the List of Southern California Butterflies.

By Fordyce Grinnell, Jr.

In the Bulletin of the Southern California Academy of Sciences, Vol. IV. No. 3, March 1905, Prof. J. J. Rivers gives a list of butterflies found within the area of Southern California, in which are enumerated 107 species. A number of the species have since been found to have been wrongly determined, partly due to the author of the present paper; since then a number of important books and papers have been published and more collecting done, so that it is time that a supplement to this list be published.

W. G. Wright's Butterflies of the West Coast, issued in October 1905, notwithstanding its many errors, idiosyncrasies, etc., added a lot of information on the Californian butterflies, prompted more work, and will become a classic. Grinnell & Grinnell, in the Journal of the New York Entomological Society, XV, 1, 37-49, 1907, published a paper on the butterflies of the San Bernardino Mountains, California. W. S. Wright in the same Journal published an Annotated List of the Diurnal Lepidoptera of San Diego County, California, based on collections during 1906-1907, XVI, 3, pages 153-167, 1908, a useful paper. Dr. Henry Skinner in Entomological News, XVIII, 9, 378, 1907, describes Thecla loki, n. sp. from San Diego County. And a few other short notes and papers. With the collections of Mr. V. L. Clemence, Mr. K. R. Coolidge, Mr. W. S. Wright and others, the butterflies are becoming better known, but there are still many vexing problems to solve, and with every addition to knowledge, more problems and complications arise.

In the following list I will give the additions and corrections to Prof. Rivers' list which occur to me, and hope it will be a spur to future work and more lists. Dr. Dyar's generic arrangement is adhered to as in the previous list, but in his A Review of the Hesperidae of the United States, of 1905, a number of generic names are changed. In the summer of 1908, the author spent three months in the San Jacinto and Santa Rosa Mountains, and a number of interesting points in distribution noted.

Papilio indra Reakirt. Should be stricken from the list. It is a Northern California species. **P. Pergamus** is its Southern representative.

Papilio coloro n. var. of Wright's Butterflies is a synonym of **Zolicaon.**

Papilio bairdii Edwards. Incorrectly named **asteroides** Reak. in Grinnell & Grinnell's List. San Bernardino Mts.

Papilio philenor Linn. Occasional at San Diego (W. S. Wright).

Synchloe australis Grinnell. Described in the Canadian Entomologist, Feb., 1908. Millard, Arroyo Seco, Eaton and probably other cañons of the San Gabriel Range and San Bernardino Range (Wright). Hemet Pk. San Jacinto Mountains, 7065 feet, May, 1908 (Grinnell). **Creusa** of Rivers' List probably refers to this species; but **creusa** may be found in Southern California.

Synchloe cethura morrisonii Edwards. Near San Bernardino (Wright).

Synchloe deserti Wright. "Garnet Knob," "Caliente" (Wright). One was taken on Little Mountain near San Bernardino this last spring by Clemence. It is a form of **cethura.**

Synchloe thoosa Scudder. Said by Wright to be the desert form of **reakirtii.** Taken in different desert localities by Wright.

Synchloe flora Wright. San Gorgono Pass (Wright). Needs investigating further, as do many other butterflies.

Synchloe mollis n. v. Wright, is an individual variation of **Sara** not worthy of a name.

Synchloe pima Edwards. Taken above Yuma on the Arizona side of the river, but undoubtedly found on the Californian side.

Synchloe caliente Wright. Colorado Desert (Wright).

Argynnis laura Edw. or **macaria** Edw. Common near Mt. Pinos, and Mt. Breckinridge, Kern County, in June 1904 and 1905.

Argynnis atossa Edwards. Tehachapi Mountains. One taken at Mt. Pinos in June, 1904, is typical **atossa**; is evidently a direct off-shoot of **laura** or **macaria.**

Lemonias quino Behr. Augusta Edw. is a synonym. San Diego, Riverside, San Bernardino, Keen Camp, etc.

Lemonias anicia Db.-Hew. San Bernardino Mountains, 6300-8500 feet elevation. Wrongly called **augusta** in Grinnell & Grinnell's List.

Thessalia leanira should be stricken from the list; **leanira** is the northern Californian form and **wrightii the** southern form.

Melitaea cerrita Wright. Is an aberration of wrightii.

Cinclidia chara Edwards. Colorado Desert. (Wright).

Chlosyne californica Wright. Colorado Desert (Wright), and San Diego County (W. S. Wright).

Polygonia chrysoptera Wright. Big Santa Anita Cañon, San Gabriel Mountains (Grinnell).

Basilarchia obsoleta Edwards. Imperial Valley. Yuma, common.

Cercyonis sthenele Boisdural. Should be stricken from the list. It was described from the San Francisco sand hills, but is supposed to be extinct. Dr. Behr had a good series in his collection (destroyed by the San Francisco fire) of this distinct species.

Cercyonis paulus Edwards. Common in the mountains.

Chrysobia mormo Felder. Colorado Desert (Wright).

Polystigma palmerii Edwards. Colorado Desert (Wright) and above Yuma (Clemence.)

Thecla nelsonii Boisduval. I took this commonly on Santa Rosa Mountain and in Strawberry Valley.

Thecla loki Skinner. Jacumba, San Diego County, W. S. Wright and Field.

Callicista ines Edwards. Desert side of Santa Rosa Mountains, Palm cañon; San Diego County, a beautiful butterfly.

Callicista columella Fab. Recorded by W. S. Wright from the city of San Diego.

Callicista avalona Wright. Santa Catalina Island, Wright and Clemence.

Incisalia eryphon Boisd. San Bernardino Mountains.

Callophrys affinis Edwards. Is undoubtedly the same as **dumetorum** Boisd.

Tharsalea hermes Edwards. San Diego.

Cupido fulla Edwards. Common on the higher parts of the San Gabriel, San Bernardino, San Jacinto and Santa Rosa Mountains. Variable and evidently beginning to form separate species.

Cupido lycea, pheres and **icarioides** should be stricken from the list.

Cupido daedalus Behr. San Bernardino Mountains and Tahquitz Valley, San Jacinto Mountains. Found in the Canadian life zone up to 8500 feet altitude. **Cupido hilda** of Grinnell and Grinnell's list is a synonym.

Nomiades antiacis, behrii, orcus and **mertila** should be stricken from the list.

Nomiades polyphemus Boisduval. The common spring Blue, found everywhere at the lower altitudes in Southern California. The butterflies figured in Bulletin, No. 1, Vol. VIII, of this Academy, belong to this species, instead of **antiacis.**

Phaedrotes sagittigera Felder. Found to be rather common in La Cañada to the Tujunga Valley, this last spring (April).

Rusticus emigdionis Grinnell—melimona Wright. San Emigdio Cañon, Kern County, and Waterman Cañon near San Bernardino.

Leptotes (?) astragala Wright. San Bernardino (Wright).

Copaeodes candida Wright. The record of **procris** in Rivers' List should be this species.

Copaeodes wrightii Edward. Mojave Desert (Wright).

Copaeodes eunus Edwards. Sierra Nevadas of Southern California (Wright).

Eudamus proteus Linn. Found by Rivers in the bean fields near Santa Monica and in Santa Monica cañon, and in San Diego (Wright, W. S.). Called the Long Tailed Skipper. A note on this was published in the Los Angeles Times.

Thorybes mexicana Herr.-Sch. Occasional.

Erynnis californica Wright. Southern California mountains.

Anthomastor pratincola Boisd. Recorded by W. S. Wright from San Diego County.

Megathymus neumoegenii Edwards. Recorded by W. S. Wright and W. G. Wright and said also to be found in the Tehachapi Mountains. A large skipper.

The **Hesperidae** are yet in a very chaotic state, and need much study.

Acrolasia tridentata. n. sp.

By Dr. Anstruther Davidson.

Low annual, short-caulescent, 5-7 cm. high; leaves lanceolate ovate, coarsely toothed, 2-3 cm. long, tapering to a broad, short petiole, midrib well marked underneath; flower 15 mm. long, short peduncled, and devoid of bracts; sepals 6 mm. long, lanceolate acute; petals five, light yellow, 12 mm. long, lanceolate ovate; filaments all expanded in lower half into flat bands, 1 mm. wide, and 3 mm. long, terminating above in three short teeth, the central one bearing the remainder of the filament and anther; fruit unknown. Whole plant is rough with the retrorse prickles of the genus, the bases of the leaves, and base of the flower pilose.

This plant comes nearest **A. tricuspis** (Gray), but it is much smaller and more hoary, and has not the conspicuous pale bracts of that species. The peculiar dilatation of the basal part of the filament easily distinguishes it from others of the genus. Type 2460, Hasse & Davidson. Banks of Haiwee Reservoir, Inyo County, April 26, 1910.

Preliminary Report of Studies of Vertebrate Blood.

By Louisa Burns, M. S., D. O.

This series of studies was begun because of the lack of reports of studies in the comparative morphology of blood. The hope is, also, studies of the development of the blood corpuscles might throw some light upon the changes in human blood under certain pathological conditions.

The hemoglobin was determined by Dare's hemoglobinometer. Normal human blood reads 100% by this instrument. The corpuscles were counted by the Thoma-Zeiss apparatus, with a counting chamber of Turck's ruling. The blood was diluted two hundred times with Toisson's fluid. The differential count was made from smears stained with eosinate of methylene blue. From five hundred to one thousand cells were counted by the differential method. The work was done in the laboratories of The Pacific College of Osteopathy, and the apparatus used was provided by that school.

The first count is that of the blood of an adult female dog. Hemoglobin, 100%,—i. e., equal to the hemoglobin of normal human blood. Erythrocytes, 6,984,000 per cubic millimeter. Each erythrocyte carries 74-100 as much hemoglobin as does each human erythrocyte. Leucocytes, 11,800 per cubic millimeter. Of these, 3.8% or 448 per cubic m. m. were large lymphocytes, resembling those of human blood. 35%, or 4130 per cubic m. m. were small lymphocytes, resembling those of normal human blood. These numbers exceed those of normal human blood.

Mononuclear neutrophiles were not found in numbers to equal 1-10 of 1%.

48%, or 5664 per cu. m. m. were polymorphonuclear neutrophiles. These were rather smaller than those found in human blood, and they are also less numerous.

10.8%, or 1274 per cu. m. m. are eosinophiles. The granules of these are larger than those of human eosinophiles, and the numbers are ten times as great as in normal human blood.

The basophiles (granular, polymorphonuclear) include 2.4%, or about 283 per cu. m .m. These resemble similar cells in normal human blood, but are about ten times as numerous. A very few amphophiles were found, less than 1-10 of 1%.

The blood serum is isotonic with human serum.

The Cat. Hemoglobin, 80%. Erythrocytes, 6,392,000 per cu. m. m. Erythrocytes smaller than human, as a rule, regular in shape, variable in size. Each erythrocyte carries 62-100 as much hemoglobin as human erythrocytes.

Leucocytes, 13,000 per cu. m. m. These stain more feebly than does human blood.

Large lymphocytes, 7%, or 910 per cu. m. m.

Small lymphocytes, 68.6%, or 8,918 per cu. m. m.

Mononuclear neutrophiles, .6%, or 78 per cu. m. m.

Polymorphonuclear neutrophiles, 20.6%, or 2,678 per cu. m. m.

Eosinophiles, 3.2%, or 416 per cu. m. m.

No basophiles were found.

Serum hypotonic to human serum.

Adult male guinea pig.

Hemoglobin, 110%.

Erythrocytes, 6,216,000 per cu. m. m. Smaller than human, but of the same form. Each erythrocyte carries 1.06 times as much hemoglobin as the human erythrocyte.

Leucocytes, 6,500 per cu. m. m.

Large lymphocytes, 2.4%, or 156 per cu. m. m.

Small lymphocytes, 35.6%, or 2,314 per cu. m. m.

Mononuclear neutrophiles, .2%, or 13 per cu. m. m.

Polymorphonuclear neutrophiles, 56.8%, or 3,692 per cu. m. m.

Eosinophiles, none found.

Basophiles, (polymorphonuclear, granular) .4%, or 26 per cu. m. m.

Amphophiles, 4.6%, or 299 per cu. m. m.

Many highly refractile granules are present. These may be singly placed, or they may appear in groups of various sizes. They do not stain in the eosinate solution.

The serum is isotonic with human blood serum.

Mouse, grown, young, male.

Hemoglobin, 80%.

Erythrocytes, 3,016,000 per cu. m. m. Erythrocytes smaller than human, irregular in size and form, though always saucer shaped and without nuclei. Each erythrocyte carries 1 2-3 times as much hemoglobin as the human erythrocyte.

Leucocytes, 9,300 per cu. m. m. Of these, 94%, or 8,742 per cu. m. m. are lymphocytes, resembling the large lymphocytes of human blood.

Small lymphocytes, 6%, or 55 per cu. m. m.

Neutrophiles and eosinophiles, absent.

Basophiles, very few, less than 1%.

Serum, hypotonic to human serum.

Adult hen.

Hemoglobin not found.

Erythrocytes, 1,992,000 per cu. m. m. The erythrocytes of the non-mammals are oval, bi-convex, nucleated cells.

Leucocytes, 64,700 per cu. m. m.

Large lymphocytes, 2.8%, or 1,812 per cu. m. m.

Small lymphocytes, 88.6%, or 57,424 per cu. m. m. The lymphocytes are much smaller than those found in human blood, and they stain very feebly.

Neutrophiles, none found.

Eosinophiles, 5.8%, or 3,763 per cu. m. m.

Basophiles, 2.5%, or 1,618 per cu. m. m.

Amphophiles, 3%, or 254 per cu. m. m.

The eosinophiles and basophiles resemble those of human blood.

Serum, isotonic with human serum.

Adult female toad.

Hemoglobin, 63%.

Erythrocytes, 526,000 per cu. m. m. The erythrocytes are oval and mostly nucleated, very irregular both in form and size. A few non-nucleated cells are seen.

Leucocytes, 27,800 per cu. m. m.

Large lymphocytes, 1%, or 278 per cu. m. m. These resemble the lymphocytes of medium size sometimes found in normal human blood.

Small lymphocytes, oval, rather deeply staining, 46.6%, or 17,058 per cu. m. m.

Small lymphocytes, round, feebly stained, 33.8%, or 9,396 per cu. m. m.

Mononuclear neutrophiles, 2%, or 556 per cu. m. m. These stain very feebly, nuclei often eccentric.

Polymorphonuclear neutrophiles, 9.2%, or 2,758 per cu. m. m. These stain very feebly, nuclei extremely irregular in form.

Eosinophiles, 1.6%, or 445 per cu. m. m. Stain very feebly. Granules irregular in size, often very large.

Basophiles, 5.8%, or 1,612 per cu. m. m. These stain with remarkable brilliancy, the granules are like those of human basophiles. They are usually mononuclear.

Serum, isotonic with human serum.

Adult goldfish.

Hemoglobin, 50%.

Erythrocytes, 935,000 per cu. m. m. Erythrocytes vary from oval to almost round, nucleated, each erythrocyte carrying nearly 27-100 as much hemoglobin as the human erythrocyte. A very few non-nucleated cells are found.

Leucocytes, 44,400 per cu. m. m.

Large lymphocytes, 3.2%, or 1,421 per cu. m. m.

Small lymphocytes, 62%, or 27,528 per cu. m. m. The lymphocytes vary greatly in their staining reactions.

Neutrophiles, 30%, or 13,320 per cu. m. m. These cells

are nearly oval varying to bluntly triangular, with small, feebly staining granules. They usually have a single nucleus, very eccentrically placed, often in contact with the periphery of the cell for more than half the circumference of the nucleus.

Eosinophiles, none found.

I. Basophiles, nuclei centrally placed, 2%, or 888 per cu. m. m.

II. Basophiles, nuclei eccentric and in contact with cell periphery, 2.8%, or 1,343 per cu. m. m.

Serum, hypotonic to human serum.

Further studies will be reported as the counting is completed.

Transactions of the Academy.

OCTOBER.

The first lecture of the season of 1909-1910 was given by Professor James Z. Gilbert on Monday evening, October 4, 1909, in Symphony Hall.

His subject was "The extinct fauna of the Southwest, as represented by numerous fossils of extinct animals discovered at La Brea Rancho."

A large attendance was in presence and a very pleasant episode of the evening was the music of the young ladies' Glee Club of the Los Angeles High School.

In introducing his subject, Prof. Gilbert paid a tribute of thanks to Mrs. Erskine M. Ross for her gracious allotment of a tract on her ranch, and the liberality of Mr. John D. Hooker and the Council of Los Angeles, which had enabled him to carry on the excavations without cessation throughout the entire summer.

Upon the screen he presented views of the small lake in the eucalyptus grove and explained the geological and paleontological conditions of the district surrounding this unique deposit of fossils.

The ancient spring of water, gushing through a bed of asphaltum, was a fatal trap to hold to their death the numerous animals of earth and air, which resorted to this place to quench their thirst.

A most interesting collection, in an excellent condition of preservation, of the fossils of the lion, the sabre-toothed tiger from infancy to old age, the wolf, mastodon, giant sloth, camel, horse, antelope, small rodents of numerous species, the peacock, the great condor, and the ancestors of the eagle, and many other animals whose descendants are now found only in tropical lands, was placed upon exhibition, and their characteristics explained by the Professor, and at the close of the address these remains were examined by the intensely interested audience.

At a meeting of the Directors in Symphony Hall on October 4, 1909, at 7:30 o'clock p.m., all were present except Dr. Bullard and Mr. Baumgardt.

It was resolved to organize a Musical or Harmony Section, and the matter was placed in the hands of Professor Watts, with power to act.

It was also decided to admit to membership boys of the Los Angeles High Schools, and to permit them to pay their dues by labor in the excavation work, under the charge of Professor Gilbert.

The Board adjourned to meet on Friday, October 8th, in the office of the Academy, at 4 o'clock p. m., to act upon other matters of importance which have been presented for consideration.

The Board of Directors held a meeting on Friday, October 8, 1909, at 4 o'clock p. m., in room 625, San Fernando Building.

Present: Messrs. Watts, Spalding, Davidson, Collins, Parsons and Whiting.

Professor James Z. Gilbert was in attendance upon invitation of the Directors.

A communication was presented from Mr. George La Mont Cole, of Pasadena, asking whether this Academy will consider a proposition from the Field Columbian Museum of Chicago, Ill., to join with us in the excavations at the Rancho La Brea, sharing with this Academy in the results.

The Secretary was instructed to inform Mr. Cole that any proposition of this character must come directly from the authorities of the Field Museum, who are empowered to act, and the terms and conditions under which the Field Museum may desire to join with us in the prosecution of said excavations must be stated clearly and in detail before this Board would consider the subject.

Professor James Z. Gilbert and Mr. William A. Spalding were unanimously elected Fellows of this Academy.

It was ordered that the dues of all persons elected to membership in this Academy during the last three months of the year shall be credited to them for the entire succeeding year, and that the dues of $3.00 for one year shall be paid before the application for membership will be considered.

The Secretary was authorized to purchase a blank book for scraps and miscellaneous items of news relating to this Academy and its members.

A vote of thanks was given to the young ladies of the Glee Club of the Los Angeles High School, for the music rendered at the last meeting of the Academy.

The following gentlemen were elected to membership, viz.: Ralph C. Daniels, 813 North Avenue 65, City; A. L. Cavanagh, 1415 Fourth Avenue, City; M. S. Moore, 1035 West Thirtieth Street, City; H. W. Stanton, 760 Whittier Street, City; John V. Frederick, 2530 E. Third Street, City; and W. A. E. Noble, 1139 Forest Avenue, Hollywood.

Professor Gilbert presented a report of his receipts and expenses in the prosecution of the excavations on Rancho La Brea, which was approved and ordered to be recorded. Said report is as follows, to-wit:

"FINANCIAL STATEMENT OF FUNDS OF THE SOUTHERN CALIFORNIA ACADEMY OF SCIENCES.

Zoological Section.

Receipts.

John D. Hooker	$150.00	
City Council	500.00	
Private, several members	23.50	
		$673.50

Disbursements.

Labor	$502.11	
Expense	37.45	
		$539.56
Balance on hand		$133.94

Bills unpaid (approximate), labor, $55.00."

The Secretary was instructed to extend to Professor W. H. Housh, Principal of the High School, an expression of the appreciation of this Board for his kindness in furnishing room in the High School building for the work of cleaning the fossils lately excavated and giving them a secure place for storage.

Board adjourned.

At a meeting of the Directors on Friday, October 15, 1909, there were present Messrs. Bullard, Parsons, Watts, Collins, Keese and Spalding.

Mr. Fordyce Grinnell, Jr., of 572 Marengo Avenue, Pasadena, was elected to membership.

In view of the valuable acquisition of fossils from Ranco La Brea; the tender of geological and zoological collections; the necessity for the proper housing and care of these valuable contributions to science, and the increasing needs of the Academy, it was resolved to place before the members and the public generally, a formal statement of the financial requirements of the Academy, and solicit subscriptions, to enable us to continue a work which has been so fruitful of results.

A vote of thanks was unanimously given to Mr. John D. Hooker for an additional gift of $500.00 for the prosecution of the excavations in Rancho La Brea.

Board adjourned.

The Geological Section was convened October 15, 1909, at the residence of Mr. S. J. Keese, No. 1509 Shatto Street.

Professor William L. Watts was elected Chairman and George W. Parsons was chosen Secretary for the year 1909-1910.

Mr. Parsons gave a most interesting account of the location of the springs, wells and water holes of the deserts in California, Nevada and Arizona, and the successful efforts made to induce the State and County authorities to erect signs throughout these arid wastes, which have resulted in the preservation of many lives by directing them to the nearest water supply.

Mr. L. W. Beck presented upon the screen many views of the desert, taken during his explorations, from Mono and Inyo Counties on the north, to San Diego on the south.

At the close of the meeting, Mr. Keese exhibited with his lantern some beautiful views of Lake Tahoe and vicinity.

NOVEMBER.

The regular meeting of the Academy was held on Monday evening, November 1, 1909, in Symphony Hall.

In the absence of the President and Vice-President, the assembly was called to order by the Secretary, and Professor Dozier was requested to preside.

The subject for discussion was "The Desert, its Geologic and Scenic Features, and Guide-Posts to Water."

Mr. George W. Parsons related events of his journeys across the gold-producing arid lands of Mono, Inyo, Kern and San Bernardino Counties and the southwestern portion of Nevada.

During the construction of the Salt Lake railroad, the remains of over thirty persons were found, and the shifting sands frequently uncover the bodies of those, whose empty water-cans told the story of their fatal wandering from a water supply. Numerous metal sign-posts have been erected throughout these deserts, with directions to the nearest water, and this life-saving work is being prosecuted as rapidly as funds become available by the State authorities and the supervisors of these Counties, who have become profoundly impressed by the representations of Mr. Parsons.

Professor William L. Watts gave a very graphic description of the geology, topography, mineral and botanical characteristics of these regions, and exhibited the necessity of these guide-posts for the saving of the lives of the numerous prospectors who, with reckless improvidence, roam over this desolate country in their mad search for gold.

Mr. L. West Beck, with his lantern, threw upon the screen views of this desert country, taken by him in his exploring trips from Mono to San Diego County.

At the close of the arranged program, Mr. Stanley McGinnis gave a short account of the discovery by Mr. George F. Clifton and himself, at Denver, Colorado, of the process of real color photography direct from nature, whereby the most delicate plants and the most picturesque landscape are shown through the negative, exactly as seen through the camera, illustrating his statement with a few views.

The proceedings of the evening were enlivened by music rendered by the High School Young Ladies' Quartet.

DECEMBER.

The announcement that the December meeting would be devoted to discussions of coelo locomotion, in view of the forthcoming aviation week in Los Angeles, resulted in a large attendance.

Mr. Charles F. Willard, of the Aeronautic Society of New York, who has made more than two hundred successful aeroplane flights, and who is to drive a Curtiss machine in the coming contests, gave a most interesting history of this new method of transportation.

The newly coined word "aviation," as distinguished from "aeronautics," refers to heavier-than-air dirigible machines driven by mechanical means. He related events in his experience, illustrating by views on the screen, the various parts of the aeronef, and its mode of ascent, operation and descent.

He was followed by Mr. George P. Harrison, Secretary of the California Aviation Society, who spoke upon aeronautics, or air-sailing, lighter-than-air machines.

He described the dirigibles of Roy Knabenshue and Count Zeppelin, and ballooning with the old type spherical bags.

The evening was one of intense interest to the Academy and its guests.

JANUARY.

The January, 1910, meeting of the Academy was devoted to the Geology and Quaternary Zoology of California.

Professor William L. Watts, in "An Outline of the Geological History of California," gave a most graphic account of the volcanic action and the tremendous erosions extending from Puget Sound to the southernmost point of Lower California, and the various uprisings and subsidence of this coast region from the Primary or Paleozoic, Devonian, Carboniferous and Permian times, down through its evolution during the Mesozoic, Triassic, Jurassic and Cretaceous period to the Eocene, Miocene and Pliocene of the Kainozoic, and ending with the quaternary times of the Pleistocene and alluvium deposits when the camel, the giant ground sloth and the sabre-tooth cat found a home in this land.

Professor James Z. Gilbert, from the platform laden with fossils excavated from the wonderful deposit in La Brea Rancho, in his discourse upon the Quaternary Life in California, related the characteristics of the now extinct fauna of two hundred thousand years ago.

The meeting resolved itself into a catechetical symposium with Professor Gilbert as the Socratic master, and his expositions of the various subjects propounded were received with marked attention and eminent satisfaction.

A meeting of the Directors was held in the office of the Secretary, on Saturday, January 8, 1910, at one o'clock p. m.

Professor James Z. Gilbert was present upon invitation.

The Secretary was instructed to inform the Trustees of the Field Museum of Natural History, in Chicago, Illinois, that owing to the conditions under which this Academy is pursuing the work of excavating at Rancho La Brea, it is impossible for us to accept any proposition for a participation with any foreign scientific body in the conduct of these investigations, and that its tender of assistance, dated November 11, 1909, must be declined.

Professor Gilbert gave a statement of the work now in progress at La Brea Rancho, and Mr. Spalding was appointed a committee to present the matter to the Board of County Supervisors and ask for an appropriation towards the expense of continued investigation.

The following named persons were elected members of the Academy, viz.: Elizabeth Yoder, Long Beach; Raymond D. Jewett, 1338 Cahuenga Street, Los Angeles.

Board adjourned.

The Directors held a meeting on January 31, 1910, at which the following gentlemen were elected members of the Academy, viz.: W. H. Wiley, W. L. Jepson, Samuel T. Tyson, Willard A. Nichols, Dr. Adolph J. Petter, Dr. Thomas Powell and Professor W. H. Housh. Mrs. Erskine M. Ross was elected an honorary member.

The President, Professor Watts, Professor Gilbert and Dr. Davidson were appointed a committee to consult with the County Supervisors in regard to the space desired by the Academy in the proposed County Museum Building to be erected in Agricultural Park.

Board adjourned.

FEBRUARY.

The regular February meeting of the Academy was held in Blanchard Hall on Saturday, the fifth.

Dr. David Starr Jordan, President of Stanford University, delivered a most interesting discourse upon the Samoan Islands and Robert Louis Stevenson, whose name as given by the natives was Tusitala, meaning the Story Teller, (Tusi, lengthwise or long; tala, talker). The flora and fauna of the Islands were illustrated by views thrown upon the screen, and in showing the wreck of the German war vessel now upon the coral reef, the story of the great hurricane was most graphically retold.

At the close of the remarks of Dr. Jordan, Professor Gilbert explained the nature of the excavations on La Brea Rancho, and exhibited to the audience many of the rare and curious fossils taken therefrom in his supervision of the work of this Academy.

NOTE: Vailema, the home of Stevenson, is a native word, from vai water, and lema, five; or the home of the five waters or springs. The name given to Dr. Jordan by the natives is Talinoa i Faiva, (Talinoa obviously related to Tala, talker), or the teller of fish stories.

A meeting of the Directors was held on Saturday, February 19, 1910, at 2 o'clock p. m., in the office of the Secretary.

Present, Watts, Parsons, Keese, Davidson and Collins.

The Secretary reported that Mr. Spalding, as President, and himself as Secretary, on behalf of this Academy of Sciences, signed an agreement with the County of Los Angeles relating to the care, supervision, control and management of the Historical Museum and Art

Gallery, about to be erected at Agricultural Park by the County. Said agreement runs for fifty years, and provides that the said Historical Museum and Art Gallery shall be controlled and managed by a Board of Governors selected as follows, viz.:

The Chariman of the Board of Supervisors;

Two persons to be selected by the Fine Arts League;

Two persons to be selected by the Historical Society;

Two persons to be selected by the Southern California Academy of Sciences;

One person to be selected by the Southern Division of the Cooper Ornithological Club;

One person at large selected by the parties hereinabove named.

Said Governors shall hold office at the pleasure of the appointing power.

The action of the President and Secretary was approved, ratified and confirmed.

Professors Hector Alliot and J. H. Francis were elected members of the Academy.

The Secretary was requested to prepare a circular setting forth the objects and aims of this Academy, and cause the same to be distributed throughout Southern California.

Professor W. L. Jepson was appointed a delegate to represent this Academy at the Brussels Congress of Botanists, and the Secretary was instructed to transmit to Professor Jepson his credentials.

Dr. Davidson and President Spalding were unanimously elected Governors of the Historical Museum and Art Gallery.

The Los Angeles Chamber of Commerce was granted permission to print an extra edition of the January Bulletin of this Academy.

Board adjourned.

MARCH.

The regular meeting of the Academy for March was held in Symphony Hall on Monday, February 28, 1910, a large audience being present.

The speaker of the evening was Professor G. W. Ritchey, of the Mount Wilson Solar Observatory. His subject was "Celestial Photography with Refracting and Reflecting Telescopes."

He gave a most interesting description of refracting and reflecting telescopes, and the process of celestial photography, demonstrating the great advantages of the reflector over the refractor in this work. The types of refracting telescopes include the portrait lens or photographic-doublet; the standard photographic refractors with double tubes, used in making the "Caste du Ciel;" the great double refractors of Potsdam and Mendon; the 36-inch Lick refractor and its photographic corrector, and the 40-inch Yerkes refractor and its photographic attachment.

The reflecting telescopes described include the 24-inch Yerkes reflector; the 60-inch Mount Wilson reflector and the 100-inch Hooker reflector now in process of manufacture.

Sixty most beautiful photographs were thrown upon the screen illustrating the results secured by the various types of telescopes. These included views of the milky way, comets, star-clusters, nebulae, and the moon. Those taken with the great 60-inch reflector were most sharp in their definition and presented minute details of comets and the moon, and particulars regarding the nebulae heretofore unknown.

At the close of the lecture, a large portion of the audience remained and entered into an animated discussion with Professor Ritchey relating to his observations and the practical work in the manufacture of astronomical instruments.

A meeting of the Directors was held April 11, 1910, at which all were present except Davidson and Hooker.

Upon the representation of the Treasurer, it was resolved to propose to the meeting of the Academy in May, an amendment to Article X of the By-Laws, whereby members of the Academy residing without a radius of thirty miles from Los Angeles shall be charged only one dollar for annual dues, and the Secretary was instructed to prepare and propose the said amendment in behalf of the Directors.

Board adjourned.

APRIL.

The monthly meeting of the Academy was held in Symphony Hall on Monday evening, April 11, 1910.

The President exhibited the plans for the new County Historical Museum and Art Gallery, showing the wing to be placed at the disposition of this Academy, and explained the nature of the arrangement of fixtures and specimens.

Mr. William H. Knight introduced the regular subject of the evening by a statement of the supposed origin of comets.

The history of Halley's comet was presented by Mr. B. R. Baumgardt in his pleasant, graphic manner, and his discourse was illustrated by many interesting stereopticon views of comets, nebulae and other celestial objects.

MAY.

The annual meeting was held on May 2, 1910, in Symphony Hall, the President in the chair.

The annual report of the Secretary was read, and an amendment to the By-laws was proposed in writing, to the following effect:

Change the second paragraph of Article X, Dues, so that it shall read as follows, viz.:

"The Annual dues of active members shall be three dollars, which must be paid to the Treasurer in January.

"Provided: That the dues of members residing without a radius of thirty miles from the city of Los Angeles shall be but one dollar per year."

Under the provisions of Article XII of the By-Laws, the proposed amendment was ordered to lie over until the next regular meeting.

Dr. Anstruther Davidson gave a description of the quarters which this Academy will occupy in the Historical Museum and Art Gallery in Agricultural Park, and the Secretary described the situation and condition of the excavations at Rancho La Brea.

The following named gentlemen were unanimously elected Directors for the ensuing year, viz.:

Arthur B. Benton, Bernhard R. Baumgardt, Holdridge O. Collins, Anstruther Davidson, John D. Hooker, Samuel J. Keese, William H. Knight, George W. Parsons, Albert B. Ulrey, William L. Watts and William A. Spalding.

Dr. James A. Cronkhite, the speaker of the evening, gave a most entertaining descriptiin of the Yellowstone National Park, and his lecture was illustrated by numerous views colored after nature, accompanied with many moving pi-tures showing the tumbling waters of the rivers and falls, the geysers in action, the travels of tourists, and the bears, buffalo, elk and other wild animals in their native habitat.

Immediately after the adjournment of the annual meeting, the Directors for the ensuing year were called to order, and the following officers were elected, viz.:

William A. Spalding .... President
Anstruther Davidson .... First Vice-President
John D. Hooker .... Second Vice-President
Samuel J. Keese.............................. Treasurer
Holdridge O. Collins .... Secretary

R. M. Bennett, of Minneapolis, Minn., was elected a life member, and Arthur L. Kelsey, Edward W. Coit, Mrs. James Sterling and Charles E. Warner, all of Los Angeles, were elected active members.

Board adjourned.

COMMITTES FOR THE YEAR, 1910-1911.

On May 5th, President Spalding appointed the following committees for the year 1910-1911:

Program.

Watts, Parsons, Ulrey.

Finance.

Keese, Baumgardt, Benton

Publication.

Collins, Davidson, Hooker.

JUNE.

A meeting of the Directors was held on Monday, June 6, 1910. Present: Keese, Spalding, Parsons, Ulrey, Watts and Collins.

It was ordered that the time for holding the regular monthly meetings of the Academy shall be the first Friday, instead of the first Monday of the month, as heretofore.

Mr. Edwin C. Opperman, of 1806 Arlington Street, was employed to collect dues from members who are in arrears for two years or more, and to canvass the city for new members, his compensation to be fifty per centum of all amounts collected through his efforts.

Mr. Robert Le Roy Beardsley, of 2515 West Twenty-first Street, was elected a member of the Academy.

Professor P. Giovanni Hagen, S. J., Director of the Vatican Observatory at Rome, was elected an honorary member.

It was ordered that the appropriation of $500.00 by the County Supervisors be devoted exclusively to the cleaning and mounting of the fossils from Rancho La Brea.

Board adjourned.

At a meeting of the Geological Section held on June 6, 1910, William L. Watts was elected Chairman and George W. Parsons Secretary.

The regular meeting of the Academy was held in Symphony Hall on June 6, 1910.

The President gave a general outline of the last year's work, and a description of the County Historical Museum and Art Gallery, now in process of construction at Agricultural Park, and the quarters therein which will be the home of this Academy.

Annual reports were presented by the Chairman of the Astronomical, Geological, Biological and Zoological Sections.

The amendment to Article X of the By-Laws, proposed at the May meeting was unanimously adopted.

The quartette of the Polytechnic High School, under the direction of Mrs. G. Parsons, rendered in a most exquisite manner the beautiful stanzas, which gave a world fame to the Oxford undergraduate Bourdillon:

"The night has a thousand eyes,
The day but one;
Yet the light of the whole world dies
With the dying sun.

"The mind has a thousand eyes,
And the heart but one;
Yet the light of a whole life dies
When love is gone."

Later in the evening, Miss Helen Mack, the soprano of this quartette, with a solo, excited the astonishment of the audience, and an enthusiastic demand for a recall. The educated musical ear of those present recognized in this gifted young maid a voice of unusual power, sweetness and culture, a promise to her of future success, and of happiness to all who shall know her.

The young gentlemen composing the Glee Club of the Los Angeles High School, through the able training of their conductor, Miss V. Blythe, have arrived at a perfection of execution and culture of voice beyond that of mere amateurs, and the songs given by them were a surprise to all, and they were greeted with most hearty applause.

Short addresses were given by Professor J. H. Francis, Principal of the Polytechnic High School, and by Professor W. H. Housh, Principal if the High School.

The members closed the season's transactions with the gratifying knowledge that the work of the Academy during the past year had been the most successful since its organization.

HOLDRIDGE OZRO COLLINS,
Secretary.

A CORRECTION.

Professor James Z. Gilbert writes the Editor that, owing to a mistake in using the wrong proof sheet, the last paragraph on page 27 of the Bulletin for January, 1910, was unintentionally printed.

Statement of Condition *of*

First National Bank

Los Angeles, California

At Close of Business, June 30, 1910

RESOURCES

Loans and Discounts		$11,564,518.87
Bonds, Securities, Etc. (Bonds Only)		1,242,600.00
U. S. Bonds to Secure Circulation		1,250,000.00
Premium on U. S. Bonds		None
Cash and Sight Exchange		5,070,754.03
	Total	$19,127,872.90

LIABILITIES

Capital Stock		$1,250,000.00
Surplus and Undivided Profits		1,768,980.45
Circulation		1,102,450.00
Reserved for Taxes		7,590.77
Deposits		14,998,851.68
	Total	19,127,872.90

Statement of Condition *of*

Farmers & Merchants National Bank

of Los Angeles

Los Angeles, California

At Close of Business July 7th, 1910

RESOURCES

Loans and Discounts	$7,599,822.66
Bonds, Securities, etc.	3,598,771.47
Cash and Sight Exchange	4,960,427.37
	$16,159,021.50

LIABILITIES

Capital Stock	$1,500,000 00
Surplus and Undivided Profits	1,950,727.37
Circulation	1,499,997.50
Deposits	11,208,296.63
	$16,159,021.50

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BAUMGARDT PUBLISHING CO., LOS ANGELES

Southern California Academy of Sciences

VOLUME X

Table of Contents and Index

1911

Contents of Volume X

Index to Volume X

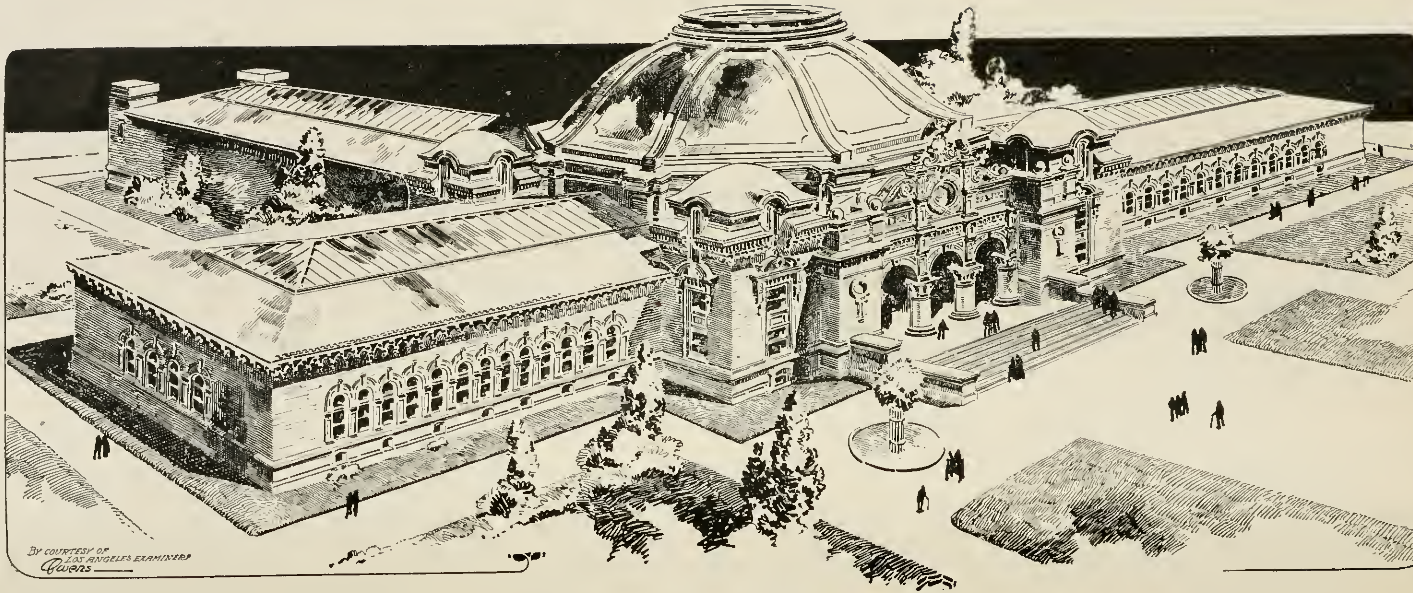
BULLETIN

OF THE

Southern California Academy of Sciences

LOS ANGELES, CALIFORNIA, U. S. A.

JANUARY, 1911



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EXPOSITION PARK, LOS ANGELES

Vol. X. Los Angeles, January, 1911. No. 1

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NEW YORK
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GARDEN.

BULLETIN

OF THE

Southern California Academy of Sciences

COMMITTEE ON PUBLICATION:

Holdridge Ozro Collins, LL. D., Chairman.
Anstruther Davidson, C. M., M. D. John D. Hooker

CONTENTS:

OFFICE OF THE ACADEMY
ROOM 625 SAN FERNANDO BUILDING

Southern California Academy of Sciences

Officers and Directors, 1910 - 1911

WILLIAM A. SPALDING.................................President
ANSTRUTHER DAVIDSON......................First Vice-President
JOHN D. HOOKER..........................Second Vice-President
SAMUEL J. KEESE.....................................Treasurer
HOLDRIDGE OZRO COLLINS..........................Secretary

Bernhard R. Baumgardt	George W. Parsons
Arthur B. Benton	Albert B. Ulrey
William H. Knight	William L. Watts

Sections of the Academy

Astronomical Section

William H. Knight, Chairman

Geological Section

William L. Watts, Chairman — George W. Parsons, Secretary

Biological Section

Clement A. Whiting, Chairman — C. H. Phinney, Secretary

Zoological Section

James Z. Gilbert, Chairman — George W. Parsons, Secretary

Botanical Section

Anstruther Davidson, Chairman

Editorial

The illustration forming the frontis-piece, represents the beautiful and extensive Structure, at this time nearly under roof, in the newly christened Exposition Park, the right wing of which has been assigned to this Academy.

On December 17, 1910, in the presence of about five thousand residents of Los Angeles, the Corner Stone was laid by the Grand Master of the Free-Masons of California, with the very impressive ceremonies of the Order. Particulars of that function are given on another page of this Bulletin in the record of the Transactions of the Academy.

The Directors are particularly gratified in being able, at this early date, to inform our members that immediately upon the completion of that Building, most valuable, interesting, beautiful and, in some respects, unique collections in Geology, Ichtheology, Conchology, Ethnology, Ornithology, Botany, Entomology and Zoology will be speedily placed in position in the large exhibition room, for inspection by the curious and examination by the student. Some of these collections have been purchased, some have been gathered at the expense of the Academy, some have been presented and a few have been loaned. Professor Gilbert has been most assiduous in his labor of cleaning and mounting the fossils from Rancho la Brea, and he reports that he now has enough skeletons to occupy the space of one side of the hall. Among them are two complete giant ground-sloths, several sabre-tooth tigers, a lion, giant wolf, foxes, coyotes, probably a complete mastodon and camel, a turtle, deer, the giant ox; and, of the creatures of the air, numerous skeletons of the giant condor, vultures, hawks, eagles, owls, herons, geese, peacocks and an innumerable quantity of creeping, crawling, walking and flying smaller fry, which possessed this region at least two hundred thousands of years ago, and which nature has embalmed and preserved in their air tight graves.

Our Academy has advanced with rapid strides into a new and more active field of work and we have faith to believe that it will be a powerful factor for good in educational and intellectual advancement on the Pacific Coast; and its labors will be appreciated and valued by all the accredited Scientific Bodies of the World.

Academia nostra magno scientiarum studio pro peritia condita, in aeternum floreat.

We have been pleased to note in journals from Rome, very flattering comments on the progressive work of Professor P. Giovanni Hagen, S. J. Director of the Vatican Observatory. On June 6, 1910, Professor Hagen was elected an Honorary Member of this Academy, and in his letter of acceptance, he notified us that we had been placed on the distributive list for the publications of the Vatican Observatory.

For many years the mystery of the twisting pines, along the Pacific Coast, has been a problem for the Forestry Commissions and the scientific Botanist. Dr. Davidson seems to have untied this Gordian knot and now, like the showing of Columbus how to stand an egg on its point, the solution seems very simple. We recommend Dr. Davidson's paper to the curious.

As Lord Byron awoke one morning and found himself famous, so the assemblage of the world's distinguished Astronomers in Los Angeles last August, was an event that gave this city, at a bound, a great advance on the list of places famous for their encouragement of the study of the most ancient and most interesting of the sciences. Using a technical word of navigation, we may be said to have established a position of new departure in our intellectual progress. We have outgrown the condition of a rural community, and probably at this time, perhaps, with the exception of Chicago, the name of no city is more generally known than Los Angeles.

Professor Hale's work on Mount Wilson and the fame of Mr. Hooker's one hundred inch reflector, attracted to us such a body of scientists, so profoundly learned and skilled in their several lines of investigation, as seldom meets in convention.

This Academy of Sciences is the only institution in the southwestern part of the United States that issues a regular publication, containing relations of investigations in all branches of Science, and it is eminently proper, that a perma-

nent record should be made by us of this most illustrious gathering. The long life of Mr. William H. Knight, one of the Founders of this Academy, has been devoted to a more or less continual study of the phenomena of the heavens, and, at this meeting, he was an honored associate of these gentlemen, with many of whom he was acquainted, and who had a great respect for his attainments. Mr. Knight has given a most interesting account of the personnel in attendance and the various transactions of the meetings on Mount Wilson, and with his article we are happy in being able to present a half-tone made from a photograph which was taken of the Members of the Convention, on the Mountain, before final adjournment.

Holdridge Ozro Collins.

Wanted

Monthly numbers of Volumes III, IV, V and VI of the Bulletin, to complete files. Address the Secretary.

Dead Pine, showing spiral twisting
Photo by B. O. Kinney

The Twisting of Pines.

Anstruther Davidson, C.M., M.D.

A few years ago when I made my first visit to the Bear Valley district in the San Bernardino Mountains, I traveled by stage on the old road by Squirrel Inn. This drive after the crest of the ridge is attained, runs through continuous forests of fir and pine and is an altogether delightful trip.

Many dead still upright trees mostly denuded of their bark are to be seen. Many of the dead trees show a spiral twist in the grain. This twisting is very conspicuous, it usually runs in this district from left to right, but quite a number run from right to left. Of the stage driver, an intelligent mountaineer I inquired what was the cause of this peculiar phenomenon. "Well you see it is this way. All pines are male or female; those with the twist in their composition are the female." That observation suggested a better acquaintance with humanity than with trees and left the question still unsolved.

This season in visiting Redondo I observed this spiral twisting in actual operation and the cause of it in this instance at least was simple enough. Very few trees in the West are absolutely symmetrical in the development of their branches. The branches on the south side or sunny side of the tree are usually markedly better developed, with denser foliage. The trade winds blowing steadily and strongly from the west all summer bear greatest pressure on the larger and denser limbs, so that the natural grain of the wood becomes twisted towards that side on which the wind produces the greatest pressure. When a number of trees grow closely in a group only those on the outside show unilateral development and those twist left or right according to the position of their heavier branches. The illustration shows this process occurring in Eucalyptus trees at Clifton, Redondo. This Eucalyptus being a fast growing tree and in a situation where the afternoon breeze is always strong shows it to an extreme degree. This twisting of the grain of the wood is probably limited to our evergreen trees with dense obstructive foliage, such as pines and Eucalypti bear. The pines thus affected are not of much value to the lumberman and it is to this fact that we owe the preservation of some of the finest trees in our present reserves. As one surveys the trees we cannot help noting that almost every large pine or Douglas spruce displays a deep gash in the trunk. That was produced by the shake splitting woodman to test the grain of the wood. If the grain was twisted the tree was no use for shakes, so it was allowed to remain and as the straight grain trees were relatively few, we have preserved to us many magnificent trees that otherwise would have long ago been sacrificed.

Eucalyptus, showing twisting in growing

Botanical Records New or Noteworthy.

Anstruther Davidson, C.M., M.D.

Streptanthus cordatus Nutt. Bear Valley Dam, in San Bernardino County.

Lepidium perfoliatum L. I found a few plants of this species on Drumholly Tract, Hollywood in May, 1910. I could find no description in the American or English Floras. Mr. Rose named it for me and remarked that it was the first specimen of the species received at Washington. Since then Mr. Heller has published a notice of its discovery in Oregon and Salt Lake City last year, so perhaps it has come to stay.

Canbya candida Parry. This tiny poppy is to be found in many places along the line of the Aqueduct from Lancaster to Inyo County.

Viola tricolor arvensis (Murr.) Abundant in the meadows at Seven Oaks, San Bernardino.

Dalea saundersii Parish. Not infrequent from near Mohave to Inyo County.

Calandrinia brewerii Wats. Found by Dr. Hasse in Topango Canyon, Los Angeles County.

Nemacladus adenophora Parish. Little Lake, Inyo County.

Eucidne urens Torr. In crevices of basaltic rocks, Little Lake, Inyo County.

Plantago bigelovii Gray. On clay bluffs, Del Mar, Orange County.

The only other recorded station for this plant in Southern California is Inglewood near Los Angeles, but it is probably present on all our sea shore cliffs.

Betula fontanalis Sargent. Haiwee Creek, Inyo County, is its most southerly limit.

Geum oregonense Rydb. Seven Oaks.

Adenostoma sparsifolium Torr. The discovery of this shrub by Dr. Hasse in Topango Canyon, Los Angeles County, is one of the most interesting discoveries of the season. It covers a space of some acres in extent.

Centaurea eriophora L. Observed on two seasons on North Avenue 50, Los Angeles. Not previously reported from the American continent.

Barlettia scaposa A. Gray. Gray reported this Mexican species as a doubtful record for the U. S.; but it grows well within our borders near Lordsburg, N. M.

Brodiaca candida Greene. I listed this species in "Plants of Los Angeles County" as **B. laxa.** and subsequently reported finding the latter near Tehachapi. In both instances it ought to have been B. candida. The species is a handsome one and is much superior to B. laxa as an ornamental plant. The name is somewhat unfortunate as it is invariably of a light blue color.

Laothoe angustifolium (Kell) Greene. Some specimens of this were sent to Mr. E. Braunton from near Riverside. Jepson's Flora gives its Southern limit as Milton, San Joaquin Valley.

Zephyranthes longifolia Hemsl. In a marsh just south of Lordsburg, N. M. This is not listed in Heller's catalogue as found in the U. S.

Phyllospadix torreyi Wats. My son Ronald gathered this at Balboa from some floating wreck. It has been reported from Santa Barbara and Catalina Island.

Notes and Additions to the List of Southern California Lepidoptera.

Fordyce Grinnell, Jr.

Thecla spadix Henry Edwards. This is one of the most local and rare butterflies in Southern California. The writer has not taken any specimens since June 1903, and then only in a very limited area along the Mt. Wilson toll road. Mr. J. E. Brown took specimens on Mt. Lowe in June 1902. It was described from one female specimen taken at Tehachapi Pass in 1884 by R. H. Stretch, and was not recorded again till 1902, nor the male described. It is a characteristic species, and is sexually dimorphic.

Rusticus monticola Clemence. Described in the Canadian Entomologist, for January 1909, from the Arroyo Seco Canyon, above Switzer's camp, San Gabriel mountains, near Pasadena, in June. Also taken on Mt. Wilson, and doubtless found on the higher parts of all the mountains. It is a good subspecies or geographical variation, and interesting bionomically.

Hemiargus isola Reakirt. A specimen was caught in Eaton's Wash, near Pasadena, June 26, 1910, by Mr. V. L. Clemence. Not previously recorded from this region.

Calpodes ethlius Cramer. This species of skipper is common in the tropical gulf states, especially Florida, where it feeds on the Canna. Mr. William Schrader bred three specimens in Los Angeles from Canna in July 1906; he has looked for it, carefully, since then, but has not rediscovered it. This is an accidental occurrence, and it may not succeed in establishing itself.

Dr. John B. Smith has recently named a few interesting Noctuidae for me, from this region, and I here give some notes on these:

Alaria felicitata Smith. The specimen I sent was the second specimen seen by Dr. Smith. I have a series of eleven specimens in my collection taken in the Imperial Valley, March 3, 1910, by Leo Goeppinger.

Deva palligera Grote. I have a specimen taken at 5500 feet elevation on the Santa Ana river, San Bernardino Mts., July 28, 1907. It is a rare species.

Euxoa recula Harvey. I have a series of thirty-eight specimens, of this somewhat variable species, taken in the Salt Wells Valley, Kern County, in October 1909.

Pronoctua pyrophiloides Harvey. I took twenty-one specimens of this, 100 feet in a mine tunnel, in the San Jacinto Mts., Cal., in June 1908.

Noctua havilae Grote. I have a good series from Mt. Wilson, and what is probably the same thing from the San Bernardino Mts.

Trichoclea nova Smith. I have this from Pasadena and Salt Wells Valley, Kern County.

Stylopoda anxia Smith. Described in the Journal New York Entomological Society, XVI, 2, 1908, p. 96, from Fort Wingate, New Mexico. I took three specimens at 4250 feet elevation, San Gabriel Mts., last July. Not before recorded from California. I have a related, but unidentified species, at a lower elevation near Pasadena, taken in the spring. The species of this group are all very rare, only occasionally taken.

Convention of Eminent Astronomers on Mount Wilson.

William H. Knight.

A body of distinguished men engaged in a special branch of astronomical research work assembled at the Solar Observatory on Mount Wilson for a four days' session from August 31 to September 3, 1910. It was the fourth conference of the International Union for Co-operation in Solar Research.

Thirteen different countries in Europe and America, and fifty different observatories and laboratories were represented. It should be remarked incidentally that the Astronomical and Astrophysical Society of America had convened at the Harvard Observatory about the middle of August, and Dr. Hale arranged to have the Solar Union meet a fortnight later so that the European members could visit Harvard on the same trip.

They did so and then came across the continent in a body, reaching their headquarters in Pasadena August 28th. On the 29th they visited the Laboratory on Santa Barbara Street and inspected the most completely equipped shops for the construction of astronomical instruments, the grinding of lenses, and the operation of spectrographic apparatus in the world. Here was a force of women computers measuring star positions on the photographic plates made at the Mount Wilson Observatory. The visiting astronomers were much interested in the extensive reference library, and pointed out to each other learned articles which they had contributed.

On Tuesday morning a line of carriages was drawn up at the Hotel Maryland and all who chose were conveyed over the new toll road constructed by the Carnegie Fund at a cost of about $50,000, for the purpose of hauling up the heavy castings and other parts of the great instruments. In my wagon were Sir Joseph Larmor, Secretary of the Royal Society; Prof. Dyson of the Royal Observatory of Scotland, since appointed Royal Astronomer at Greenwich; Prof. Barnard of the Yerkes Observatory; Dr. Ephraim Miller of the University of Kansas, and Dr. Adams of the Mount Wilson Observatory. Dr. Deslandres of the Meudon Observatory occupied Mr. Adams' place a part of the way.

The road was dusty but the crowd was jolly and enjoyed the scenery, the deep canyons, the geological formations, the magnificent mountain pines, and the grand outlook over the valley.

On the mountain we were provided with good accommodations and hotel fare. The weather was ideal. The nights were wonderfully clear and favorable for observation. Los Angeles and suburban towns in the valley below were outlined by brilliant electric lights.

On Wednesday morning, August 31, the astronomers assembled in the Museum Building near the base of the 150 foot tower. The windows were filled with beautiful transparencies, exhibiting the skillful photographic work of the observatory. Images of the solar surface sixteen inches in diameter, brilliant star clusters, numerous nebulae, comets, planets, and views of the various buildings—all fully labeled.

Prof. Arthur Schuster, of Manchester, England, chairman of the executive committee, called the meeting to order, and in accordance with programmed arrangement called Dr. Edward C. Pickering, Director of Harvard Observatory to the chair to preside for the day. At the same time he announced that Dr. W. W. Campbell, Director of the Lick Observatory, would preside on Thursday, and Prof. Edwin B. Frost, Director of the Yerkes Observatory, would preside on Friday.

It was a polyglot assembly, the members speaking various tongues. But the largest elements were English, French and German. Accordingly, three secretaries were appointed—Prof. Walter P. Adams of the Solar Observatory for the English, Prof. Pierre Puiseux of the Paris Observatory for the French, and Prof. Heinrich Konen of the Physical Institute of Munster for the Germans.

On taking the Chair Prof. Pickering spoke briefly and then introduced Dr. George E. Hale, Director of the Mount Wilson Solar Observatory for the opening address, paying him a just tribute for bringing the world's eminent astronomers to this mountain peak, and for the distinguished services he had rendered to the science of astronomy.

Dr. Hale was received with hearty applause. He most gladly welcomed his co-workers in this great field—the Universe. But not much was to be expected from this meeting in the way of material results.

Its main object was to exchange views, involving an account of work done, new methods adopted, suggestions regarding a more perfect co-operation, thus avoiding duplication, to promote a feeling of comradeship and an esprit du corps, but the main benefit would be a stimulation to do even more and better work.

Prof. Hale then rapidly summarized the work of the Solar Observatory during the past two years, and what it would aim to do in the immediate future. He clearly illustrated on the blackboard the salient features of his processes and methods, bringing out extremely technical points with great clearness.

The interest in his remarks was very great, because many of the observatories of Europe and America are now equipped with the wonderful and complicated spectroheliograph, the principle of which, and many of the improvements are Hale's invention and devices.

It is interesting to remark that if such a body of learned astronomers had assembled twenty years ago, not one of them would even have heard of such an instrument as the spectroheliograph. But today it is revealing to the world the story of the tremendous storms agitating the sun's surface, its fierce electrical and magnetic influences, the play of chemical elements in prodigious outbursts of inflamable gases.

In short, the detailed study of this monarch of the solar system, is giving us insight, or at least a hint, of the evolution of unnumbered suns in the infinite depths of the Universe.

In listening to this remarkable and versatile speaker, Dr. Hale, one ceases to wonder that he produced a strong impression when he addressed the Royal Society in London, the Academy of Sciences in Paris, and a great assembly in Rome during the past year. May his health, which is frail, be restored so that he can mature the great plan he has outlined on the ideal summit of Mount Wilson, and perhaps achieve still greater things in the future.

The report of the Executive Committee, Prof. Arthur Schuster of Manchester, England, Chairman, was then called for. The other members of the Committee were Prof. Hale of the Solar Observatory, and Prof. A. Ricco of the Seismological Observatory at Catania, Sicily.

On Wednesday evening many of the members wended their way along the serpentine paths, first to the observatory containing the 60-inch reflector presided over by Mr. Ritchey, whose genius planned it and whose skill constructed it, so that the colossal machine weighing nearly 50,000 pounds, responds to the slightest touch. There a marvelous and mysterious object came into view, the ring Nebula of Lyra, which in this telescope shows an almost transparent film quite across what in other telescopes is a vacant center, with a faint star in its midst, supposed by many to be superposed. Another astounding object was the Hercules Cluster, probably a distant universe blazing with more than 200,000 suns. What glorious constellations are figured in those wonderful skies. With unaided vision we see but 3,000 stars above the horizon at one time. Is it not possible that the night time of that distant universe is as radiant as our day?

After glimpsing a few such dazzling objects the astronomers proceeded along the dusty paths for a quarter of a mile to the Monastery, so called because it is the home of the male resident astronomers. It is situated on the brink of the most eastern projection of the summit of Mount Wilson, and commands a bewildering view of the valleys below, dotted with orchards and vineyards, towns and cities, and the blue Pacific in the far horizon. But on that memorable evening the landscape was obliterated by the darkness, but a most magical scene took its place. The electric lights of Los Angeles, Pasadena, Hollywood, Venice, Long Beach, Sierra Madre, Monrovia, Whittier and Pomona, brilliantly located those cities, and they shone with the resplendence of constellations reflected from the skies in the bosom of a vast lake.

Promptly at 9:30 a. m. on Thursday morning the astronomers were in their respective seats, eager to take up the work before them. "Solar Rotation," was the subject on which an important committee had been at work on the previous afternoon. It now made its report to the Solar Union. What was the significance of this investigation? The text books tell us that the sun rotates upon its axis in about twenty-five days and eight hours. But singular anomalies have been discovered. Portions of the sun's chromosphere seem to move faster than the body of the sun. But even this motion varies in the different latitudes.

Now these varying velocities have an important effect upon the movements of the flocculi, some of which, like the hydrogen and calcium flocculi are in the upper or superficial regions of the chromosphere, and others, like the carbon compounds lie much deeper. How strange to be talking so specifically of these chemical elements in the sun. The most optimistic astronomer would not have dreamed of such a thing half a century ago. Even a score of years ago it was a comparatively unexplored field. What may we not hope will be accomplished in the near future, by such indefatigable investigators as those who were assembled on Mount Wilson that memorable week?

International Union for Co-operation in Solar Research.

Members of the Fourth Conference.

Professor J. S. Ames,	Johns Hopkins University,	Baltimore, Md.
Mr. Charles G. Abbot,	Smithsonian Astrophysical Observatory,	Washington, D. C.
Mr. Walter S. Adams,	Mt. Wilson Solar Observatory,	
Mr. Harold D. Babcock,	Mt. Wilson Solar Observatory,	
Professor J. O. Backlund,	Observatoire de Poulkovo,	Poulkovo, Russia.
Professor E. E. Barnard,	Yerkes Observatory,	Williams Bay, Wis.
Professor A. Belopolsky,	Observatoire de Poulkovo,	Poulkovo, Russia.
M. Jean Bosler,	Observatoire de Meudon,	Meudon, France.
Professor F. P. Brackett,	Pomona College,	Claremont, Cal.
Miss Cora G. Burwell,	Mt. Wilson Solar Observatory,	
Professor W. W. Campbell,	Lick Observatory,	Mount Hamilton, Cal.
Professor C. A. Chant,	University of Toronto,	Toronto, Canada.
M. Henri Chretien,	Observatoire de Nice,	Nice, France.
Rev. P. R. Cirera, S. J.,	Observatorio del Ebro,	Tortosa, Spain.
Dr. W. W. Coblentz,	Bureau of Standards,	Washington, D. C.
Rev. A. L. Cortie, S. J.,	Stonyhurst College Observatory,	Lancashire, England.
M. A. Cotton,	Ecole Normale Superieure,	Paris, France.
M. H. Deslandres,	Observatoire de Meudon,	Meudon, France.
Professor N. Donitch,	Observatoire de l'Universite,	St. Petersburg, Russia.
Mr. Frank L. Drew,	Mt. Wilson Solar Observatory,	
Professor F. W. Dyson,	Royal Observatory,	Edinburgh, Scotland.
Mr. Ferdinand Ellerman,	Mt. Wilson Solar Observatory,	
Dr. P. Eversheim,	University of Bonn,	Bonn, Germany.
Professor Charles Fabry,	Universite de Marseilles,	Marseilles, France.
Dr. Edward A. Fath,	Mt. Wilson Solar Observatory,	
Mrs. W. P. Fleming,	Harvard College Observatory,	Cambridge, Mass.
Mr. F. E. Fowle,	Smithsonian Astrophysical Observatory,	Washington, D. C.
Professor A. Fowler,	Imperial College of Science and Technology,	South Kensington, London, England.
Professor Philip Fox,	Dearborn Observatory,	Evanston, Ill.
Professor E. B. Frost,	Yerkes Observatory,	Williams Bay, Wis.
Dr. Henry G. Gale,	University of Chicago,	Chicago, Ill.
Professor L. H. Gilmore,	Throop Polytechnic Institute,	Pasadena, Cal.
Miss Clementina D. Griffin,	Mt. Wilson Solar Observatory,	
Professor George E. Hale,	Mt. Wilson Solar Observatory,	
M. M. Hamy,	Observatoire de Paris,	Paris, France.
Professor J. Hartmann,	Koenigliche Sternwarte,	Goettingen, Germany.
Professor K. Haussmann,	Technische Hochschule,	Aachen, Germany.
Prof. J. V. Hepperger,	Imperial Observatory,	Vienna, Austria.
Major E. H. Hills,	32 Prince's Garden,	London, England.
Professor W. J. Humphreys,	U. S. Weather Bureau,	Washington, D. C.
M. Idrac,	Observatoire de Meudon,	Meudon, France.
Professor J. C. Kapteyn,	Astronomical Laboratory,	Groningen, Holland.
Professor H. Kayser,	University of Bonn,	Bonn, Germany.
Dr. Arthur S. King,	Mt. Wilson Solar Observatory,	
Professor H. Konen,	Physikalisches Institut,	Muenster, Germany.
Professor F. Kuestner,	Koenigliche Sternwarte,	Bonn, Germany.
Mr. C. O. Lampland,	Lowell Observatory,	Flagstaff, Ariz.
Sir Joseph Larmor,	Royal Society,	London, England.
Miss Jennie B. Lasby,	Mt. Wilson Solar Observatory,	
Professor A. O. Leuschner,	University of California,	Berkeley, Cal.
Professor H. C. Lord,	Emerson McMillin Obsy.,	Columbus, Ohio.
Professor A. G. McAdie,	U. S. Weather Bureau,	San Francisco, Cal.
Dr. Walter M. Mitchell,	Detroit Observatory,	Ann Arbor, Mich.
Professor H. F. Newall,	University Observatory,	Cambridge, England.
Mr. F. G. Pease,	Mt. Wilson Solar Observatory,	
Professor E. C. Pickering,	Harvard College Observatory,	Cambridge, Mass.
J. S. Plaskett, Esq.	Dominion Observatory,	Ottawa, Canada.
Comte A. de la Baume Pluvinel,	Rue de la Baume,	Paris, France.
Professor E. Pringsheim,	University of Breslau,	Breslau, Germany.
Professor P. Puiseux,	Observatoire de Paris,	Paris, France.
Professor A. Ricco,	Osservatorio astrofisico,	Catania, Sicily.
Professor W. G. Ritchey,	Mt. Wilson Solar Observatory,	
Professor A. L. Rotch,	Blue Hill Observatory,	Hyde Park, Mass.
Dr. Henry Norris Russell,	Princeton University,	Princeton, N. J.
Professor J. R. Rydberg,	University of Lund,	Lund, Sweden.
Dr. Charles E. St. John,	Mt. Wilson Solar Observatory,	

Professor Fernando Sanford,	Leland Stanford Jr. University,	Palo Alto, Cal.
Dr. Frank Schlesinger,	Allegheny Observatory.	Allegheny, Pa.
Professor Arthur Schuster.	Victoria Park,	Manchester. England.
Professor K. Schwarzschild.	Astrophysikalisches Observatorium,	Potsdam. Germany.
Professor F. H. Seares.	Mt. Wilson Solar Observatory,	
Dr. V. M. Slipher.	Lowell Observatory,	Flagstaff. Ariz.
Professor Frederick Slocum,	Yerkes Observatory,	Williams Bay. Wis.
Miss Ruth E. Smith.	Mt. Wilson Solar Observatory.	
Professor S. W. Stratton,	Bureau of Standards.	Washington. D. C.
Professor H. Struve.	Koenigliche Sternwarte.	Berlin. Germany.
Professor S. D. Townley,	Leland Stanford. Jr., University.	Palo Alto. Cal.
Professor H. H. Turner,	University Observatory.	Oxford, England.
Miss Louise Ware.	Mt. Wilson Solar Observatory,	
Miss Phoebe Waterman.	Mt. Wilson Solar Observatory,	
Professor F. R. Watson.	University of Illinois.	Champaign, Ill.
Professor H. C. Wilson.	Goodsell Observatory.	Northfield, Minn.
Professor A. Wolfer.	Sternwarte des Eidgenossischen Polytechnikums.	Zurich, Switzerland.

Accredited Visitors.

John D. Hooker. Los Angeles. donator of 100-inch lens.
Wm. H. Knight. Los Angeles. astronomical writer.
Edgar L. Larkin, Lowe Observatory. Echo Mountain. Cal.
Dr. James D. Maddrill. Ukiah Observing Station. Cal.
Dr. Ephraim Miller. University of Kansas.
Rev. Jerome S. Ricard. Santa Clara College.

The Instrumental Equipment on Mount Wilson consisted of:

The 60-inch reflecting telescope. mounted in a steel observatory 75 feet in diameter. with double walls to equalize the temperature. and actuated entirely by the touch of an electric button. Accessories to it were plate holders for direct photography. and a device for producing an 18-foot stellar spectograph. Some of the cluster photographs taken by Prof. Ritchey excel in delicate detail anything produced by any other instrument.

The Snow Horizontal telescope has a mirror of 24 inches aperture. and a focal length of 60 feet. Accessories. an 18-foot solar spectograph. a 5-foot spectroheliograph. and a device for direct photography of the sun.

The 60-foot Tower Telescope. with an objective of 12 inches aperture. Accessories. a 10-foot solar spectograph. for the study of sunspot spectra. spectrum of the chromosphere. etc., and a 10-foot spectroheliograph.

The new 150-foot Tower Telescope, unfinished. will give a solar image 17 inches in diameter. I believe the largest produced elsewhere is 8 inches. Accessories. combined spectrograph and spectroheliograph with prisms and gratings of a wide range of dispersion. It will be equipped with apparatus for the study of magnetic fields in sunspots.

Those directly concerned in these investigations are: George E. Hale, Ferdinand Ellerman. Walter S. Adams, Edward A. Fath. Arthur S. King. Charles E. St. John, W. G. Ritchey, Harold D. Babcock, F. H. Seares. Henry G. Gale.

The facilities of the Observatory have been extended to Prof. J. C. Kapteyn, of the Groningen Observatory during the past two seasons, in connection with his investigations in "Star Streams."

There was manifest throughout the proceedings of this body of distinguished scientific men, a magnanimous appreciation of the achievements of their fellow workers, that was exceedingly gratifying to the impartial spectator. It reminded Dr. Ephraim Miller, for 36 years Professor of Mathematics and Astronomy in the University of Kansas at Lawrence, of an incident he witnessed at the dedication of the Yerkes Observatory in the early 90s.

Dr. Simon Newcomb, one of America's great astronomers presided on that occasion. Not far from him, on the front seat, in view of the large audience, sat three astronomers, neither of them in dress suits, and not expecting nor desiring to become conspicuous in the proceedings. They were Emerson E. Barnard, discoverer of the fifth satellite of Jupiter; S. W. Burnham, who had discovered a large number of double stars; and Geo. E. Hale, the inventor of the spectroheliograph.

In the course of his address Newcomb spoke of his recent visit to the principal observatories of Europe. At the Paris Observatory the Director remarked that you have a great astronomer on the other side of the Atlantic. Besides finding and photographing many new comets he had the keen vision to detect the fifth satellite of Jupiter, which our astronomers had failed to discern till Barnard pointed it out and told us where to look for it. Whereupon Burnham and Hale reached over and with smiles and approving nods patted Barnard on the back, to the great amusement of the audience.

Proceeding Dr. Newcomb said that at the great Pulkowa Observatory in Russia, the Director who was famed for his double star discoveries, said you have a great astronomer in America who has done most remarkable work with a six-inch telescope, having discovered more double stars than any other astronomer except those connected with this observatory. Your people ought to pay high honors to Mr. Burnham for his valuable discoveries. And then Barnard and Hale reached over and patted Burnham on the back, amid hearty applause.

Again resuming his reminiscences, Dr. Newcomb said that when he visited the noted astrophysical observatory at Potsdam, the Director remarked that you have a genius over in America. The man who could think out, devise and invent

that remarkable instrument—the spectroheliograph, deserves the thanks of every astronomer on the globe. And then Barnard and Burnham reached over and slapped Hale on the back amid the heartiest applause of the audience.

It is this magnificent spirit, this disposition to accord to fellow-workers the praise due to their efforts in solving the mysteries of the Universe, this unselfish co-operation for great and worthy ends, that make the work to which astronomers have devoted their talents and their lives, as beautiful as the star-spangled vault of heaven at night, and as sublime as the truths they are striving to reveal regarding the bright worlds, the vast siderial systems, and those other universes in the infinite depths of space, of which our photo-telescopes give but faint glimpses.

But more beautiful than the star-gemmed skies, more sublime than the rolling spheres of heaven's infinite deeps, is the divine grasp of the human mind, which, anchored for a few fleeting years on this rushing, whirling ball, the earth, yet boldly reaches out to the utmost bounds of space, reduces the intricate maze of myriad worlds to orderly systems, and deduces the eternal laws of matter and force which govern them, literally unifying all this wonderful phenomena of suns and planets, comets and nebulae, clusters and galaxies, into one grand, well-ordered and harmonious Universe.

Transactions of the Academy.

DECEMBER.

The first meeting of the Academy for the Season of 1910-1911, was held on Monday evening, December 5, 1910 in Symphony Hall.

The President, Mr. Spalding, reported progress in the erection of the new County Museum Building in Agricultural Park, and, in a view thrown upon the screen, he pointed out the wing which will be the home of this Academy, and explained the conveniences which will be placed at our disposal. He invited all present to attend the ceremonies of the laying of the Corner Stone on the afternoon of December 17, 1910.

The lecture of the evening was by Thomas Powell, M.D. upon "The Appropriation of Food and the Energy derived therefrom by Animal Life," which was illustrated by many interesting views.

The lecture was followed by considerable discussion from members of the different schools of medicine, which disclosed theories widely divergent from the propositions advanced by the lecturer, each claiming that his scheme was orthodox and all others heterodox.

The Directors held a meeting in the office of the Secretary on Saturday December 10, 1910, those present being Spalding, Benton, Parsons, Keese, Watts, Knight and Collins.

The Secretary reported that he had been requested to take charge of the selection of records to be sealed in the Copper Box which will be deposited in a cavity of the Corner Stone of the new County Museum Building, to be laid by the Most Worshipful Grand Master of Ancient, Free and Accepted Masons of California, on Saturday December 17, 1910, and he asked for instructions from the Directors as to what documents of this Academy should be selected for that collection.

He was directed to have the Articles of Incorporation, Certificate of the Secretary of State and List of Members of the Academy, printed in a suitable form, and, with Volumes VIII and IX of the Bulletin and a short type-written History of the Academy, to be prepared by Mr. Knight, placed in the Box. The Secretary was also instructed to send to all members, a circular, informing them of the time and place of the ceremonies connected with the laying of the Corner Stone and to include with said Circular a silk badge upon which shall be printed the words "Academy of Sciences."

Board adjourned.

Record is hereby made, that on Saturday, December 17, 1910, the tract of land heretofore known as Agricultural Park, was given the new designation of Exposition Park, the christening being done by the young maid Mary Spencer Bowen, with water brought from Owens River especially for this purpose.

At the laying of the Corner Stone of the Building, which has been devoted to the work of this Academy of Sciences and kindred Associations, the only persons upon the platform with the Officers of the Grand Lodge of Free and Accepted Masons of California, were the President, Secretary and Director George W. Parsons of this Academy; and the Copper Box, containing the historical records and memoranda which had been assembled by the Secretary, was by him placed in the cavity of said Corner Stone.

Among the Documents sealed in said Box, were a type-written History of this Academy of Sciences, by Mr. William H. Knight, one of its Founders: A copy of the Articles of Incorporation and Certificate by the Secretary of State: Volumes VIII and IX of the Academy Bulletin, and a List of the present Officers and Members.

HOLDRIDGE OZRO COLLINS,
Secretary.

ARTICLES OF INCORPORATION

of the

Southern California Academy of Sciences

KNOW ALL MEN BY THESE PRESENTS!

That we, the undersigned, all of whom are citizens and residents of the State of California, do hereby voluntarily associate ourselves together for the purpose of incorporating under the laws of the State of California,

AND WE HEREBY CERTIFY

FIRST:

That the name of said Corporation shall be
SOUTHERN CALIFORNIA ACADEMY OF SCIENCES.

SECOND:

That the purposes for which said Corporation is organized are, to promote intercourse among those who are cultivating science; to elicit public interest in the results of technical investigation, by the dissemination of correct information relating thereto; the study of local natural features and phenomena, and the purchase and erection of suitable buildings for a Library and the conservation of material illustrating all phases of science.

THIRD:

That the place where the principal business of said Corporation is to be tranacted is the City of Los Angeles, in the County of Los Angeles, State of California.

FOURTH:

That the term for which said Corporation is to exist is fifty years from and after the date of its incorporation.

FIFTH:

That the number of its Directors shall be eleven, and the names and residences of the Directors who are appointed for the first year are as follow, to-wit:

Name.	Residence.
Bernhard R. Baumgardt,...........	Los Angeles, California:
William H. Knight,................	Los Angeles, California:
John D. Hooker,....................	Los Angeles, California:
Melville Dozier,....................	Los Angeles, California:
Samuel J. Keese,...................	Los Angeles, California:
Holdridge O. Collins,...............	Los Angeles, California:
G. Major Taber,.....................	Los Angeles, California:
John S. Vosburg,..................	Los Angeles, California:
George W. Parsons,................	Los Angeles, California:
Anstruther Davidson,..............	Los Angeles, California:
Clement A. Whiting,...............	Los Angeles, California:

That a meeting of said Association was held in the said City of Los Angeles, State of California, on the eleventh day of May, 1907, at which meeting a Majority of the members of said Association was present and voted.

Bernhard R. Baumgardt was elected Chairman, and Holdridge O. Collins was elected Secretary, and upon the count of the votes cast the above named gentlemen were duly elected Directors for the first year.

IN WITNESS WHEREOF, We have hereunto set our hands, this 11th day of May, 1907.

BERNHARD R. BAUMGARDT
WILLIAM H. KNIGHT
JOHN D. HOOKER
JOHN S. VOSBURG
SAMUEL J. KEESE
HOLDRIDGE O. COLLINS
G. MAJOR TABER
GEO. W. PARSONS
ANSTRUTHER DAVIDSON
CLEMENT A. WHITING

State of California }
County of Los Angeles } ss.

Bernhard R. Baumgardt and Holdridge O. Collins being severally duly sworn according to law, on oath depose and say, that at a meeting of the above named Association, held in the City of Los Angeles, State of California, on the 11th day of

May 1907, a majority of the members thereof was present and voted:

That Bernhard R. Baumgardt was elected Chairman, and Holdridge O. Collins was elected Secretary, and that the following gentlemen, to-wit:

Bernhard R. Baumgardt, William H. Knight, John D. Hooker, Melville Dozier, Samuel J. Keese, Holdridge O. Collins, G. Major Taber, John S. Vosburg, George W. Parsons, Clement A. Whiting and Anstruther Davidson, were unanimously elected Directors for the first year of its incorporation.

Bernhard R. Baumgardt
Holdridge O. Collins

Subscribed and sworn to before me
this 11th day of May 1907.

J. E. Wiseman
Notary Public in and for the
County of Los Angeles, State of California.

NOTARIAL
SEAL

State of California
County of Los Angeles } ss.

I, J. E. Wiseman, a Notary Public in and for Los Angeles County, State of California, do hereby certify that BERNHARD R. BAUMGARDT, WILLIAM H. KNIGHT, JOHN D. HOOKER, MELVILLE DOZIER, SAMUEL J. KEESE, HOLDRIDGE O. COLLINS, G. MAJOR TABER, JOHN S. VOSBURG, GEORGE W. PARSONS, CLEMENT A. WHITING and ANSTRUTHER DAVIDSON, who are personally known to me to be the persons whose names are subscribed to the foregoing instrument, personally appeared before me this day and acknowledged that they signed and executed the same.

NOTARIAL
SEAL

In Witness whereof, I have hereunto set my hand and affixed my Notarial Seal, this 13th day of May 1907.

J. E. Wiseman
Notary Public in and for the County of Los Angeles, State of California.

Filed
May 14, 1907

C. G. Keyes, Clerk

By W. C. Watson, Deputy

No. 50479

STATE OF CALIFORNIA

Department of State.

I, C. F. Curry, Secretary of State of the State of California, do hereby certify that a copy of the Articles of Incorporation of

SOUTHERN CALIFORNIA ACADEMY OF SCIENCES

certified by the County Clerk of the County of Los Angeles as a copy of such Articles filed in his office, was filed in this office on the 17th day of May A. D. 1907, which Articles and the copy thereof contained the required Statement of Facts, to-wit: First, the name of the corporation as aforesaid; Second, the purpose for which it is formed; Third, the place where its principal business is to be transacted; Fourth, the term for which it is to exist; Fifth, the number of its directors or trustees, and the names and residences of those who are appointed for the first year;

And I do hereby further certify that the Articles of Incorporation set forth the holding of the election for directors, the time and place when the same was held, that a majority of the members of such association were present and voted at such election, and the result thereof; which facts were verified by the officers conducting the election.

Witness my hand and the Great Seal of State at office in Sacramento, California, this the 17th day of May, A. D. 1907.

C. F. CURRY
Secretary of State

By J. Hoesch
Deputy

BY-LAWS

of the

Southern California Academy of Sciences

ARTICLE I.

Meetings.

The Annual Meeting of this Academy shall be held on the first Monday of May, at which the Directors for the ensuing year shall be elected.

All meetings of the Academy and of the Board of Directors shall be conducted under the usual Parliamentary Rules.

ARTICLE II.

Officers.

The officers shall be a President, a First and a Second Vice-President, a Secretary and a Treasurer, who shall be elected by the Directors from their number.

ARTICLE III.

Standing Committees.

There shall be the following standing committees, to-wit:

Committee on Finances,
Committee on Publication,
Committee on Program,

and such other committees as the Directors shall, from time to time, think advisable to organize.

ARTICLE IV.

President.

The President shall preside at all meetings of the Academy and of the Directors;

He shall appoint all committees, of which he shall be **ex officio** a member, and he shall have power to call special meetings of the Academy, and to convene the Board of Directors at his discretion.

In his absence or inability to act, the Vice-Presidents, in the order of seniority, shall assume his duties.

ARTICLE V.

Secretary.

The Secretary shall record all the proceedings of the Academy, of the Board of Directors, and of the several Sections; maintain an alphabetical roll of the membership of the Academy; conduct the correspondence, and perform such other duties as the Directors or his office may require.

He shall certify all acts of the Academy and Board of Directors, and, when required, authenticate them under seal.

He shall have charge of the Corporate Seal, and all the records of the Academy, except such as pertain to the duties of the Treasurer, and supervise the printing of all notices and other publications.

In his absence, a Secretary **pro tempore** may be appointed by the presiding officer.

ARTICLE VI.

Treasurer.

The Treasurer shall collect all moneys due the Academy, and keep all funds and securities under instructions by the Directors;

He shall pay all current bills against the Academy, and all bills of an unusual nature which shall be authorized by the Directors, and at each annual meeting render an account of all receipts and disbursements.

ARTICLE VII.

Directors.

The Directors may be convened at any time by the Secretary upon request in writing by three members.

They shall have control and management of all the affairs and properties of the Academy.

Five shall be a quorum for the transaction of any business.

They may organize standing or special committees, as they think proper; employ such managers or other assistants as may be necessary, and fix the salaries of all officers or employees.

They shall elect all members of the Academy; all Fellows, Honorary and Corresponding Members.

A majority vote of the quorum shall be necessary to elect any applicant to membership, and no one shall be elected a Fellow, an Honorary or Corresponding Member of this Academy against whom three negative votes shall be cast.

In case of a vacancy in their number by reason of death, resignation, continued absence, or for any other cause, they shall have the power to fill the vacancy for the unexpired term.

In all proceedings other than the election of Fellows, Honorary and Corresponding Members, a majority vote of the quorum shall constitute the action of the Directors.

They shall have power to organize department Sections, corresponding in scope to individual branches of science.

ARTICLE VIII.

Membership.

The Academy shall be composed of Active, Honorary, and Corresponding Members.

Any of the Active members who have been distinguished in literary or scientific work may be granted the Degree of Fellow by the Directors, as provided in Article VII.

Honorary and Corresponding membership may be conferred upon persons not active members. Such Honorary and Corresponding members shall be exempt from dues, and they shall have the right of participating in the discussions of the Academy, but they shall have no vote and hold no office, nor be appointed upon any committee.

A candidate for Active membership shall be recommended by two members, upon the form prescribed by the Directors, and the annual dues of three dollars for the current year shall accompany the application.

Members shall receive without charge all publications by the Academy, except such as may be issued by subscription.

ARTICLE IX.

Department Sections.

Department Sections, embracing individual branches of science, may be organized under regulations prescribed by the Board of Directors.

Each Section shall elect a Chairman and a Secretary and such other officers as it may think proper, and it shall be independent in its management except in those matters subject to control by the Directors.

No associate of any Section shall have the right to vote therein unless he is an active member of the Academy.

All Sections shall present to the Academy, at its regular meeting in June, a report of its proceedings during the year.

ARTICLE X.

Dues.

No admission fee shall be required.

The annual dues of Active Members shall be three dollars, which must be paid to the Treasurer in January:

Provided: That the dues of members residing without a radius of thirty miles from the City of Los Angeles shall be but one dollar per year.

No assessments for any purposes whatsoever shall be levied upon members.

Any member paying the sum of one hundred dollars shall be placed in the class of Life Members, and shall thereafter be exempt from all dues.

ARTICLE XI.

Seal.

The Seal of this Corporation shall be of the following design, to-wit:

Upon the circumference of a circle the words

SOUTHERN CALIFORNIA ACADEMY OF SCIENCES,

and in the center thereof,

Incorporated
1907.

ARTICLE XII.

Amendments.

These By-Laws may be amended or superseded in the following manner:

The proposed amendments or changes shall be presented in type-writing at any regular meeting of the Academy, and lie over for one month at least. At the next regular meeting they shall be placed before the Academy for action, and a majority vote in favor thereof by the members present shall be necessary for their adoption.

State of California, }
County of Los Angeles, } ss.

I, Holdridge Ozro Collins, Secretary of the Corporation, Southern California Academy of Sciences, do hereby certify that the foregoing document is a true and correct copy of the Code of By-Laws of the said Southern California Academy of Sciences, which said Code was unanimously adopted by the said Corporation on the Twenty-eighth day of May, 1907, and amended on May 2, 1910.

HOLDRIDGE OZRO COLLINS,
Secretary.

ROLL OF MEMBERS

of the

Southern California Academy of Sciences

The Names of Fellows are Starred

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L A Pacific Co

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G E Bailey
R F D 4, Box 226

Professor C F Baker
Claremont

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2710 Michigan Ave

Prospero Barrows
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626 W 30th

Mars Baumgardt
626 W 30th St

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1007 Bonnie Brae St

Geo H Beeman
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R M Bennett
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*Dr Edith J Claypole
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Pacific Col Osteopathy

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John L Whitaker
First National Bank

W H Wiley
367 S Bonnie Brae

Elizabeth Yoder
Long Beach

Statement of Condition of

First National Bank

Los Angeles, California

At Close of Business, June 30, 1910.

RESOURCES

Loans and Discounts	$11,564,518.87
Bonds, Securities, Etc. (Bonds Only)	1,242,600.00
U. S. Bonds to Secure Circulation	1,250,000.00
Premium on U. S. Bonds	None
Cash and Sight Exchange	5,070,754.03
Total	$19,127,872.90

LIABILITIES

Capital Stock	$ 1,250,000.00
Surplus and Undivided Profits	1,768,980.45
Circulation	1,102,450.00
Reserved for Taxes	7,590.77
Deposits	14,998,851,68
Total	$19,127,872.90

Statement of Condition of

Farmers & Merchants National Bank of Los Angeles

Los Angeles, California

At Close of Business, July 7th, 1910

RESOURCES

Loans and Discounts	$ 7,599,822.66
Bonds, Securities, etc.	3,598,771.47
Cash and Sight Exchange	4,960,427.37
	$16,159,021.50

LIABILITIES

Capital Stock	$ 1,500,000.00
Surplus and Undivided Profits	1,950,727.37
Circulation	1,499,997.50
Deposits	11,208,296.63
	$16,159,021.50

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Baumgardt Pub. Co., Los Angeles

BULLETIN

OF THE

Southern California Academy of Sciences

LOS ANGELES, CALIFORNIA, U. S. A.

JULY, 1911

JOHN DAGGETT HOOKER.
1838–1911

Vol. X. Los Angeles, July, 1911. No. 2

LIBRARY NEW YORK BOTANICAL GARDEN

BULLETIN

OF THE

Southern California Academy of Sciences

COMMITTEE ON PUBLICATION:

Holdridge Ozro Collins, LL. D., Chairman.
Anstruther Davidson, C. M., M. D. Arthur Burnett Benton.

CONTENTS:

OFFICE OF THE ACADEMY
ROOM 625 SAN FERNANDO BUILDING

Southern California Academy of Sciences

Officers and Directors, 1911-1912

WILLIAM A. SPALDING.................................President
ANSTRUTHER DAVIDSON.................... First Vice-President
WILLIAM L. WATTS........................Second Vice-President
SAMUEL J. KEESE.......................................Treasurer
HOLDRIDGE OZRO COLLINS.............................Secretary

Hector Alliot	William H. Knight
Bernhard R. Baumgardt	George W. Parsons
Arthur B. Benton	Albert B. Ulrey

Sections of the Academy

Astronomical Section

William H. Knight, Chairman

Geological Section

William L. Watts, Chairman — George W. Parsons, Secretary

Biological Section

Clement A. Whiting, Chairman — C. H. Phinney, Secretary

Zoological Section

James Z. Gilbert, Chairman — George W. Parsons, Secretary

Botanical Section

Anstruther Davidson, Chairman

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GARDEN

Editorial.

AT the City of Los Angeles, on May 24, 1911, departed this life, John Daggett Hooker.

His achievements in Southern California covered a wide field of activities, and the great number of those who knew him in the scientific, commercial and social world will see him no more. Only the memory of his struggles, his successes, his benefactions and his gentle individuality remains. To those of this Academy of Sciences, with whom he was more intimately associated, his death has come as a personal affliction. Identified with us, almost from its institution, he was a powerful factor in the work which has resulted in our present success, and so he continued until the end. His closing years were devoted to an enthusiastic study of the problems in Astronomy, and the great one-hundred-inch Reflector, now in process of manufacture for Mount Wilson, will be an enduring monument to him who conceived the idea of such a telescope, and who made it possible by his munificent endowment.

In the Bulletin for January, 1909, something was related concerning the character of Mr. Hooker and the progress made in the construction of this instrument, which he so eagerly desired to see completed and in whose work he was so lavish of his time and pecuniary support. What he vainly hoped to see in the realms of outer space, will be revealed to the generations which will follow, and as we sadly erase his name from the active list of members of this Academy we may take a mournful satisfaction in the knowledge that he was one of us, and that our Academy will be associated with his name, so long as his great benefaction shall endure.

At our regular meeting of June 10, 1911, Mr. William H. Knight introduced a Memorial, which was unanimously adopted. It may be read upon another page of this Bulletin.

Pursuant to the arrangements made with the Carnegie Institution at Washington, in September 1906, Mr. John Daggett Hooker placed an order with the French Plate Glass Companies at St. Gobain, France, for the casting of a glass disk one hundred inches in diameter to be used for a reflecting telescope on Mt. Wilson, near Los Angeles, California.

In December, 1908, the glass disk, 102 inches in diameter, 13½ inches thick and weighing 4½ tons, reached Pasadena. Prof. Ritchey immediately discovered that in many respects the disk was imperfect. It had been cast or poured from three pots in succession, giving an effect of three layers, and it contained millions of air bubbles and striae which gave it a milky appearance; therefore it showed an entire lack of homogeneity so necessary for equable expansion and contraction of a perfect mirror disk.

It was then thought that this disk could not be made available and Mr. Ritchey departed almost immediately for France, with the request from Mr. Hooker that he stay long enough to see the institution of proceedings for a perfect casting. Mr. Ritchey remained at St. Gobain several months and gave his time and experience to this problem, but although many castings have been made, down to the present time, no perfect disk has been achieved.

The use of metal for reflectors has practically been abandoned. Metal is fibrous and granular in the finest castings, and irregularities in its surface will be apparent after the most careful polishing. No combination of iron, tin, zinc or aluminium can give a surface equal to what may be obtained from a vitreous substance; hence the insuperable superiority of glass, quartz or other vitreous matter, which can be polished to such a degree of perfection that a microscopic inspection will reveal no irregularities in its polishing or in its silvering. It will appear as limpid and pure as a transparent liquid surface. Another factor in the superiority of glass over metal is its greater rigidity, so that it is less subject to flexure.

It has been a subject of inquiry why a glass disk, even with air bubbles and other imperfections in the interior, will not be as good as a perfect casting, inasmuch as its surface will be silvered, and no part of the glass itself will be visible or used as a reflector. If these imperfections are so far within the disk, below the surface, that in grinding and polishing they are not reached, it will be possible to use the castings, but by reason of its not being homogeneous, it will be subject to unequal or irregular expansion and contraction throughout the entire body. The manufacturers at St. Gobain overlooked this fact, and although they knew of these interior blemishes, in sending the casting they evidently thought that it would answer, as it could be given a perfect surface.

Upon a more careful examination of this disk, Mr. Ritchey found that the nearest imperfection would be about ¼ of an inch below the surface when polished and figured, and after

vainly waiting nearly two years for a better casting, he decided to use this casting, which can be replaced in its mounting by a perfect one, if such shall ever be obtained, and he has proceeded with this work with excellent results in the Hooker building at Pasadena.

Mr. Ritchey is very courteous and obliging in imparting information to visitors and I am under obligations to him in being allowed to inspect the entire works and for the details of his proceedings. This casting is now upon the huge machine undergoing its first grinding with the grooved iron plate and carborundum, which is sharper and harder than emery.

At this writing the center of the parabolic curve has been ground about one inch below the face of the circumference. When completed this point will be 1¼ inches below the edge, which is finished, and the back has been polished so that it can be silvered, if experience shall show this desirable, to counteract unequal expansion and contraction, which may be caused by changes of temperature upon the silvered face and unsilvered back. The parabolic curve will be figured to 3-1000000 of an inch of perfection and its focus will be 41 2-3 feet. The focus of the 60-inch reflector now in use on Mt. Wilson is only 25 feet. For this 100-inch reflector there will be five small mirrors, which will be used in combination with the large one. These are cast and await polishing.

At least eighteen months more, perhaps two years, will be required before this instrument will be ready for use, and with the expense of the proposed buildings, its cost will amount to several hundreds of thousands of dollars.

With the 60-inch reflector Mr. Ritchey has taken some most wonderful photographs of nebulae which cannot be seen, even by the 40-inch Yerkes equatorial at Lake Geneva, Wisconsin. These photographs show distinctly the mysterious dark rifts and nebulous stars now in process of evolution to other systems, and the Directors of this Academy will probably be able to make arrangements with Prof. Ritchey to exhibit these photographs, illustrating a lecture before the Academy during the coming season.

The construction of the Museum Building in Exposition Park is nearly completed, and we expect to take possession in August or early in September. So soon as the desks, stands, cases and shelving for our Library shall be in place, our Collections will be rapidly assembled in the several departments and the doors thrown open to all students in the various branches of Science, and to the public. We hope to have everything arranged at the commencement of our work for the next season.

Holdridge Ozro Collins.

In Memoriam

JOHN DAGGETT HOOKER

May 10, 1838, Hinsdale, New Hampshire
May 24, 1911, Los Angeles, California

The Southern California Academy of Sciences has suffered an irreparable loss in the recent death of its Vice President, John D. Hooker, who for nearly a score of years has been identified with its work and interests, and has been one of its most active and useful members.

For a considerable period the Astronomical Section held its monthly sessions in a hall specially fitted up for the purpose at his colonial residence on Adams Street. His deep interest in that branch of science was shown by his donation to the Mount Wilson Solar Observatory of a lens one hundred inches in diameter to be used in producing the most powerful reflecting telescope on the globe, thus enabling astronomers to penetrate further into the profound depths of space than has heretofore been done.

On various occasions the Academy has received from his abundant means valuable pecuniary aid in the furtherance of scientific research. Yet all his benefactions were given without ostentation, and his self-effacement was such that he did not care to have these services mentioned in the meetings of the Academy, but it is due to his memory that they should now be fully acknowledged.

The good works of every man of a noble nature live after his mortal remains have been consigned to the tomb, and the memory of our departed brother will be cherished in the hearts of all those members of the Academy who have been associated with him for so many years.

This tribute of respect will be inscribed on our records, and we extend our sincere condolence to the members of his bereaved family.

A Census of the Land and Fresh-water Mollusks of Southwestern California.

Harold Hannibal.

GENERAL REMARKS.

The recent visit of Dall, the appearance of a new edition of "West Coast Shells," and the promise in time of a dependable manual of the "marines" has given an added stimulus to interest in conchology in southern California, a bit of the world which, during recent years, has contributed generously toward the increase and diffusion of knowledge along this line. This has resulted in several requests for a systematic account of the land and fresh-water shells of the region.

Realizing that, with the frequent changes perpetrated in the nomenclature, a mere check-list would shortly occupy a position of honor among the conchological antiquities, while these same alterations and numerous others to follow before the classification is placed on a strictly genetic basis, preclude the preparation of a contribution as extensive as a manual, an attempt has been made to embody the desirable features of both in the following pages. The usefulness of a check-list is thereby retained, but the paper possesses the added advantage of value to one who would delve into the intricacies of "why and wherefore."

The portion dealing with the terrestrial species, in the preparation of which, Mr. Henry M. Edson of Palo Alto, California, has assisted, follows. Part two, which treats of the aquatic forms, will appear in a succeeding number.

The Los Angeles System.

The area under consideration has been termed the Los Angeles System*. This lies south of the great divide formed by the crest of the Santa Ynez, San Gabriel, and San Bernardino Mountains and westerly from the San Jacinto, Cuyamaca, and San Pedro Martir Ranges. The bulk of the system falls in southwestern California, but a narrow arm extends south along the west coast of Baja California to the vicinity of San Sebastian Viscaino Bay. It includes not only the California—Baja California mainland, but the islands off the coast, the Channel, Santa Barbara, Coronado, San Martin, and Cerros groups.

As regards terrestrial and aquatic mollusca the area comprises a natural faunal unit. The fauna is partially interme-

*West Coast Shells, 1910, p. 300.

A Good Place for Glyptostoma, Upper Sonoran near Grapevine Mine, Cuyamaca Mountains, California.

The Home of Thysanophora, Canadian Cienega in Upper Mission Canon, San Bernardino Mountains, California.

diate in facies between that of the Coast Range and Arizona Systems of the California Province, and the Baja California System of the Mexican Province, but contains a number of peculiar species, particularly helicies, while **Micrarionta,** the group of maritime **Epiphragmophoras** is almost wholly restricted within its limits.

PART I—LAND MOLLUSCA.

Henry M. Edson and Harold Hannibal.

Factors of Distribution.

The distribution of the Los Angeles System land Mollusca, as with land mollusks in general, is strictly in accordance with the life-zones recognized by botanists, mammalogists, and ornithologists. Abrams* admits four such zones in this portion of California, the Canadian, Arid Transition, Upper Sonoran, and Lower Sonoran.

FAUNAS OF THE LIFE ZONES.

The Canadian Zone, belt of the Lodge-pole Pine, Limber Pine, Glaucous Willow, and Quaking Aspen, includes the high mountain cienagas and the upper slopes of the highest peaks. Landshells in this zone are by no means rare, but consist wholly of minute widespread forms.

The following occur† :

†Euconulus fulvus
Punctum californicum
Pyramidula cronkhitei
†?Succinea stretchiana
†Thysanophora ingorsolli
***?Vertigo occidentalis**
†Vitrina alaskana
Zonitoides arboreus
Zonitoides pugetensis

In the Arid Transition zone, belt of the Yellow Pine, Sugar Pine, and White Fir, embracing the forested areas of the higher mountains, terrestrial mollusks are infrequent in southern California, due not improbably to the unfavorable ground-cover afforded by the pines, which form the predominate portion of the flora.

The following species are known or may be looked for in the forest belt:

?Amalia hewstoni
Ariolimax columbianus
Punctum californicum
Punctum conspectum
Pyramidula cronkhitei
?Succinea streetiana
Zonitoides arboreus
Zonitoides pugetensis

*Abrams, LeRoy; A Phytogeographic and Taxonomic Study of the Southern California Trees and Shrubs, 1910, p. 307 ff.

†An asterisk preceding a species indicates that it is confined to the zone in which it occurs and is restricted to the Los Angeles System, a dagger that it is characteristic of the zone in which it is found, two daggers that it is introduced. A question mark denotes that further study is necessary to settle the zonal distribution.

The wooded lower mountain slopes, chaparral-covered hills, and grassy valleys compose the Upper Sonoran Zone, belt of Big-cone Douglas Spruce, California Walnut, Live Oak, Cañon Oak, Wild Lilac (**Ceanothus spinosus**), Manzanita (**Uva-ursti tomentosa, U. pungens**), Birch-leaf mahogany, Chamise (**Adenostoma fasciatum**), California Bay, White Alder, Maritime Prickly-pear, and Sycamore, which forms the great bulk of the Los Angeles System. Landshells are frequently rare, particularly in the more arid portions, and hardly ever abundant, but, as landshells go in southern California, this zone furnishes the most accessible and prolific collecting. All the large helicies, several minute species, and the introduced forms are restricted within its limits.

The following are found:

***Agriolimax hemphilli**
†?Amalia hewstoni
***?Anadenulus cockerelli**
Ariolimax columbianus
***Bifidaria calamitosa**
***Bifidaria clementina**
***Bifidaria hemphilli**
***Binneya notabilis**
†Circinaria duranti
***Circinaria transfuga**
†Epiphragmophora areolata
†E. areolata crassula
***Epiphragmophora ayresiana**
***Epiphragmophora gabbi**
***E. gabbi rufocincta**
***Epiphragmophora intercisa**
***Epiphragmophora kelletti**
***E. kelletti tryoni**
†Epiphragmophora traski
†Epiphragmophora tudiculata
***Glyptostoma newberryanum**
††Helix aspersa
††Limax flavus
††Limax maximus
Punctum californicum
Punctum conspectum
***Pupa sterkiana**
Pupoides chordata
†Succinea oregonensis
†Succinea sillimani
†Vallonia pulchella
†Vertigo californica
***?V. californica catalinaria**
***?V. californica diegoensis**
***?V. californica elongata**
††Vitrea cellaria
***Vitrea diegoensis**
Zonitoides arboreus
†Zonitoides milium
†Zonitoides minisculus

The Lower Sonoran zone, belt of Fremont Cottonwood, Dudley's Willow (**Salix vallicola**), Bebbia, and the Cacti (except the maritime Prickly-pear), of the arid flood plains and valley bottoms contains, so far as known, no land shells.

SYSTEMATIC CATALOG*.

*The general arrangement proposed by Pilsbry, (Naut. XI, 1897, p. 45 ff) is adhered to in the following pages with the exception of the grouping of the **Arionidae** and **Pupidae**, subsequently revised by Pilsbry and Ferris (Proc. Phila. Acad. Nat. Sci., 1898. p. 226 ff and 1900, p. 582 ff), which classification is adopted.

HELICIDAE.

Helix aspersa Muller.

Fig.; **Pomatia aspersa** Binney, Manual Am. Land Shells, 1885, p. 470, fig. 514.

Seaports and principal cities, introduced from Europe.

Upper Sonoran.

Long Beach (J. H. Paine); Los Angeles (Mrs. T. S. Olroyd); Redlands (S. S. Berry) fide Berry.

Glyptostoma newberryanum (W. G. Binney).

Fig.; Binney, Manual, 1885, p. 153, fig. 135, 135½.

Syn.: **G. newberryanum** var. **depressum** Bryant, Naut. XVI, 1902, p. 70.

Lives under rocks on bare hillsides. (See figure 1.)

Upper Sonoran.

Los Angeles (H. Hemphill) fide Hemphill, (Mrs. W. F. Ball); Santa Ana Cañon (Miss C. Soper) fide Soper; Pasadena, fide Pilsbry; "Temescal Mountains, near Los Angeles" (W. H. Brewer) fide Newcomb; San Pedro (L. G. Yates) fide Cooper; Wilmington (H. Hemphill) fide Bryant.

||*Near San Diego (J. S. Newberry) fide Binney, (H. Hemphill), (E. W. Roper), (R. H. Hamilton); Pamoosa Cañon, fifteen miles north of Escondido (F. W. Kelsey) fide Kelsey; Campo (Mexican Boundary Survey) fide Dall; twenty miles north of San Diego (H. Hemphill) fide Binney; hills north of Foster (Mrs. C. Stevens); Lakeside (C. W. Gripp); Santee (C. W. Gripp).

Bluffs north of Ensenada, lat. 53 deg. (F. W. Bryant) fide Bryant; Todos Santos Island, lat. 53 deg. (H. Hemphill) fide Binney; Nachoguero Valley near California Boundary (Mexican Boundary Survey) fide Dall.

Epiphragmophora areolata (Sowerby).

Fig.; **Polymita areolata** Tryon, Am. Jour. Conch. II, 1866, p. 319, Pl. XXIII, fig. 5.

Syn.; **Helix levis** Pfeiffer, Zeit. fur Mal., 1845, p. 152; **H. pandorae** Forbes, Proc. Zool. Soc. Lon., 1850, p. 55, Pl. IX, fig. 3 a-b; **Arionta Veitchii** (error for **Veatchii** Newcomb MS.) Tryon, Am. Jour. Conch. II, 1866, p. 316, Pl. XXII, fig. 19, Pl. XXIII, fig. 6; III, p. 162; **H. areolata** var. **examinata** J. G. Cooper, Proc. Cal. Acad. Sci., III, 1892, p. 216, 341, Pl. XIV, fig. 7; **E. pandorae benitosensis** Pilsbry, Proc. Phila. Acad. Nat. Sci. 1898, p. 70; **E. leucanthea** Dall, Proc. Phila. Acad. Nat. Sci., 1900, p. 99, Pl. VIII, fig. 18, 20.

E. pandorae appears to be distinguishable from **areolata** only by the color of the apex, a character insufficient for varietal separation.

||Type localities are distinguished by an asterisk.

Upper Sonoran.

Baja California from San Quintin, lat. 30 deg. 24 min. to Cape San Lucas, chiefly on the western side of the peninsula, but occurs on Espirito Santo Island, lat. 24 deg. 30 min., in the Gulf of California.

Cedros or Cerros Island, lat. 28 deg. 02 min. (J. A. Veach) fide Newcomb, (A. W. Anthony) fide Dall, (W. H. Ochsner), Natividad Island, lat. 27 deg. 62 min. (A. W. Anthony) fide Dall; San Benito Island (A. W. Anthony) fide Dall, (W. H. Ochsner); Los Benitos Islands, fide Pilsbry, (Mexican Boundary Survey) fide Dall; El Rosario Mesa, lat. 29 deg. 50 min. (C. R. Orcutt) fide Cooper;? San Tomas, lat. 31 deg. 35 min. (W. M. Gabb) fide Gabb; "San Juan del Fuaco" (Kellett and Wood) fide Forbes; San Quintin, lat. 30 deg. 24 min. (C. R. Orcutt) fide Cooper.

Epiphragmophora areolata crassula (Dall).

Fig.; **E. crassula** Dall, Proc. Phila. Acad. Nat. Sci., 1900, p. 100, Pl. VIII, fig. 3.

This subspecies, which bears an analogous relation to **areolata** that **tryoni** does to **kelletti**, has been referred to by Binney under the name of **Euparypha levis** (Pfeiffer). Pfeiffer's type was a dwarf specimen of **areolata**. The only available name is **crassula** Dall. Occasionally specimens in any considerable series of **areolata** are referable here.

Rosalia Bay, lat. 28 deg. 30 min. (A. W. Anthony) fide Dall; *Natividad Isalnd, lat. 27 deg. 62 min. (A. W. Anthony) fide Dall; San Geronimo (W. H. Ochsner).

Epiphragmophora ayresiana (Newcomb).

Fig.: **Arionta ayresiana** Binney, Manual, 1885, p. 138, fig. 117.

This species was reported by Binney (loc. cit. p. 494) from San Clemente Island (L. G. Yates). The record has not been verified by subsequent collectors and is probably erroneous.

Upper Sonoran.

*Santa Cruz Island (W. Newcomb) fide Cooper, (L. G. Yates) fide Yates, (H. Hemphill) fide Hemphill; Santa Rosa Island (L. G. Yates, H. Hemphill) fide Binney; San Miguel Island (W. C. W. Harford) fide Binney, (C. P. Streator); Middle Anacapa Island (L. G. Yates) fide Yates.

Epiphragmophora contracostae Pilsbry.

Fig.; **Arionta californiensis** Lea var. **ramentosa** Gould (Small var.) Binney, Manual, 1885, p. 133, fig. 108.

Syn. **E. californiensis** var. **contracostae** Pilsbry, Naut. IX, 1895, p. 72; **E. arnheimi** Dall, Proc. U. S. Nat. Mus. XVIII, 1895, p. 6.

Dall (loc. cit.) reports this species from Nachoguero Valley near the California boundary, Baja California (E. A. Mearns).

The identification is unquestionably erroneous. It was probably based on a specimen of **E. traski.**

Epiphragmophora gabbi (Newcomb).

Fig.; **Arionta gabbi** Binney, Manual, 1885, p. 148, fig. 129-131.

Syn.; **Helix facta** Newcomb, Proc. Cal. Acad. Sci., III, 1864, p. 118; **Helix tenuistriata** Binney and Bland, L. and F. W. Shells N. Am., I, 1869, p. 75, fig. 305 (not of A. Binney, 1842); **E. catalinae** Dall, Proc. Phila. Acad. Nat. Sci., 1900, p. 103; **Helix** var. **feralis** Hemphill, Naut., XIV, 1901, p. 121, Pl. I, fig. 2.

Upper Sonoran.

*San Clemente Island (J. G. Cooper) fide Newcomb, (H. Hemphill) fide Hemphill, (Mexican Boundary Survey) fide Dall; Santa Barbara Island (J. G. Cooper) fide Newcomb, (H. Hemphill) fide Dall; Santa Catalina Island (H. Hemphill) fide Binney; San Nicholas Island (J. G. Cooper) fide Newcomb.

Epiphragmophora gabbi rufocincta (Newcomb).

Fig.; **Arionta ruficincta** Binney, Manual, 1885, p. 147, fig. 128; **E. (Micrarionta) guadeloupiana** Dall, Proc. Phila. Acad. Nat. Sci., 1900, p. 101, Pl. VIII, fig. 14-15.

Distinguished from **gabbi** by its usually larger size, more depressed form and broad rather than subperforate or closed umbilicus. Intergrading forms are frequent.

*Santa Catalina Island (J. G. Cooper) fide Newcomb, (H. Hemphill) fide Hemphill. Guadeloupe Island, lat. 29 deg. (E. Palmer, G. W. Dunn) fide Binney, (A. W. Anthony, Snodgrass and Heller) fide Dall.

Epiphragmophora intercisa (W. G. Binney)

Fig.; **Arionta intercisa** Binney, Manual, 1885, p. 137, fig. 114, 115.

Syn.; **Helix crebristriata** Newcomb, Proc. Cal. Acad. Sci., III, 1864, p. 116; **H. redimita** W. G. Binney, Proc. Phila. Acad. Nat. Sci., 1857, p. 183.

Varieties **elegans** Hemph., **nepos** Hemph., **albida** Hemph., **minor** Hemph., **callojunctis** Pils., **castanea** Humph. and **hybrida** Hemph. have been distinguished on the basis of size, development of sculpture, and color. These are probably of the nature of fluctuating rather than mutational variations.

Reported, doubtless erroneously, from Santa Cruz Island by Pilsbry.

*San Clemente Island (J. G. Cooper, W. Newcomb, H. Hemphill) fide Binney, (Mexican Boundary Survey) fide Dall, (R. H. Tremper), (H. Lowe).

Epiphragmophora kelletti (Forbes).

Fig.; **Arionta kelletti** Binney, Manual, 1885, p. 149, fig. 132.

Syn.; **Helix stearnsiana** Gabb, Am. Jour. Conch., III, 1867, p. 235, Pl. XVI, fig. 1; **E.** (var.?) **clementina** Dall, Proc. Phila. Acad. Nat. Sci., 1900, p. 103; **E. Orcutti** Dall, loc. cit. p. 104, Pl. VIII, fig. 19.

Color forms **albida, castaneus, nitidus, multilineata, frater, californica, forbesii,** and **bicolor** have been named by Hemphill. Were these varieties of any evolutionary significance the names are nearly all preoccupied in the literature.

Upper Sonoran.

Santa Catalina Island (H. Hemphill) fide Hemphill, (R. H. Tremper); cañon back of Avalon, Santa Catalina Island (Mrs. E. M. Gaylord); San Clemente Island (H. Hemphill, U. S. Fish Commission, Mexican Boundary Survey) fide Dall, (J. G. Cooper) fide Newcomb, (R. H. Tremper).

San Diego (R. H. Tremper), (C. R. Orcutt) fide Cooper, (J. G. Cooper) fide Newcomb; Pacific Beach (F. W. Kelsey) fide Kelsey, (C. W. Gripp); Point Loma (E. W. Roper) fide Roper, (C. W. Gripp); Campo (Mexican Boundary Survey) fide Dall; Ocean Beach (Mexican Boundary Survey) fide Dall; Lakeside (C. W. Gripp); near Monument 258, Mexican Boundary (Mexican Boundary Survey) fide Dall; 2,000 feet elevation, twelve miles east of San Diego (H. Hemphill) fide Binney.

Coronado Islands, near California Boundary (R. E. C. Stearns) fide Binney, (Mexican Boundary Survey) fide Dall, (H. Hemphill) fide Cooper, (C. W. Gripp); San Benito Island, lat. 28 deg. 20 min. (W. H. Ochsner); San Martin Island, lat. 30 deg. 30 min. (W. H. Ochsner), (A. W. Anthony) fide Dall; El Rosario Mesa, lat. 29 deg. 50 min. (W. M. Gabb) fide Cooper, (C. R. Orcutt) fide Dall; San Ysidro Rancho, near California Boundary (Mexican Boundary Survey) fide Dall; San Tomas River, lat. 31 deg. 35 min. (H. Hemphill) fide Binney; Todos Santos Island, lat. 31 deg. 53 min. (H. Hemphill) fide Binney, (A. Dean); *"San Juan del Fuaco" (Kellett and Wood) fide Forbes.

Epiphragmophora kelletti hemphilli nom. nov.

Syn.; **Helix tryoni** var. **subcarinata** Hemphill, Zoe, I, 1891, p. 332.

Since **subcarinata** is already preoccupied several times in **Helix,** the name of this variety is changed to **hemphilli.** Subcarinate and more depressed than **kelletti.** Semifossil.

*Santa Barbara Island (H. Hemphill) fide Hemphill.

Epiphragmophora kelletti tryoni (Newcomb).

Fig.; **Euparypha tryoni** Binney, Manual, 1885; p. 153, fig. 137.

Varieties, **varius, nebulosa, fasciata, californica, albida, maculata, major** and **minor** are recognized by Hemphill. Distinguished from **kelletti** by the more elevated spine and dentate aperture.

*Santa Barbara Island (W. Newcomb) fide Newcomb, (H. Hemphill) fide Binney; *San Nicholas Island (W. Newcomb) fide Newcomb, (H. Hemphill) fide Binney, (H. Lowe).

Epiphragmophora traski (Newcomb).

Fig.; **Arionta traski** Binney; Manual, 1885, p. 143, fig. 122.

Syn.; **Helix Carpenteri** Newcomb, Proc. Cal. Acad. Sci., II, 1861, p. 103; **Helix remondi** Tryon, Am. Jour. Conch. II, 1866, p. 313.

Hemphill has named a variety **cuyamacaensis.** Specimens from localities where the supply of lime is insufficient are frequently separated, as **E. carpenteri.** Often associated with the next species.

Upper Sonoran.

Foothills of the Sierra Nevada Mountains from Tulare County, Coast Ranges from Fresno and San Luis Obispo Counties, south to southern extremity of Baja California, where it occurs on the east side of the Peninsula as well.

Near Point Conception (A. E. Yates) fide Cooper; Santa Barbara (A. W. Crawford) fide Binney, (W. H. Brewer) fide Newcomb; Santa Inez Mountains back of Santa Barbara (I. B. Hardy); Coldspring Cañon, Santa Barbara (C. L. Lawton, H. Hannibal); Tejon Pass at old Fort Tejon (W. M. Gabb) fide Cooper, (H. Hannibal).

Los Angeles (J. B. Trask) fide Trask; Malibou Cañon at mouth of Cold Creek (H. Hannibal); Smael's Ranch, one mile above ocean, Temescal Cañon, Santa Monica (H. Hannibal); swamp between Palms and Cienaga, Los Angeles Coastal Plain (H. Hannibal); dried up swamp southeast of Baldwin Station, Los Angeles Coastal Plain (H. Hannibal); Arroyo Seco, Pasadena (Miss C. Soper) fide Soper.

Small cañon near Ontario (R. H. Tremper) fide Berry; San Antonio Cañon, two miles from mouth (R. H. Tremper) fide Berry; mouth of Stoddard's Cañon (R. H. Tremper) fide Berry.

San Diego (H. Hemphill) fide Binney, (J. G. Cooper) fide Cooper, (C. W. Gripp); Palus Cañon, Cuyamaca Mountains (C. R. Orcutt) fide Orcutt; Snow Cañon, Cuyamaca Mountains (C. R. Orcutt) fide Orcutt; near gold mines, Cuyamaca Mountains (H. Hemphill) fide Cooper; La Jolla (C. W. Gripp); Ross Cañon, near Pacific Beach (C. W. Gripp).

Coronado Islands, near California Boundary (C. W. Dunn, H. Hemphill) fide Cooper, (C. W. Gripp); Guadaloupe Island, lat. 29 deg. (W. E. Bryant) fide Cooper; Trinidad, lat. 28 deg. 45 min. fide Cooper; mouth of San Tomas River, lat. 31 deg. 35 min. (H. Hemphill) fide Binney.

Epiphragmophora tudiculata (A. Binney).

Fig.: **Arionta tudiculata** Binney, Manual, 1885, p. 139, fig. 118.

Syn.; **A. tudiculata** var. **cypreophila** (Newcomb M. S.) Binney loc. cit. p. 140, fig. 119; **Helix tudiculata** var. **subdolus** Hemphill, Naut. IV, 1890, p. 41.

Varieties **umbilicata** Pils., **Binneyi** Hemph., and **tularensis** Hemph. have been described from the northward distribution of this species.

Upper Sonoran.

Calaveras County south through the foothills of the Sierra Nevada Mountains to Tehachapi, west to San Luis Obispo County, south to Baja California Boundary.

Head of Bell's Cañon; Simi Hills (H. Hannibal); Smael's Ranch, one mile above ocean, Temescal Cañon, Santa Monica (H. Hannibal); Gabriel (Miss C. Soper) fide Soper; Arroyo Seco, Pasadena (Miss C. Soper) fide Soper; San Pedro (D. Arnold), (J. G. Cooper) fide Newcomb.

Mentone (S. S. Berry) fide Berry; Highland (S. S. Berry) fide Berry; Arrowhead Hot Springs (S. S. Berry) fide Berry; San Bernardino (R. H. Tremper, S. S. Berry) fide Berry; Ontario (R. H. Tremper) fide Berry; southeast of Ontario, seven miles from foothills (R. H. Tremper) fide Berry; 2,500 feet, Frankish Cañon (R. H. Tremper) fide Berry; mouth of Stoddard's Cañon (R. H. Tremper) fide Berry; Temescal Cañon, three miles north of Elsinore (J. S. Hook); San Jacinto Valley (H. Hemphill) fide Hemphill.

San Diego (J. G. Cooper) fide Newcomb, (H. Hemphill) fide Binney, (Mexican Boundary Survey) fide Dall, (E. W. Roper); Pamoosa Cañon, fifteen miles north of Escondido (F. W. Kelsey) fide Kelsey; Spring Valley, one mile north of S. V. Post Office (H. Hannibal); El Nido (Mexican Boundary Survey) fide Dall; Santee (C. W. Gripp); La Jolla (C. W. Gripp); Mission Valley (C. W. Gripp); San Buenaventura, fide Binney; "near Mexican Boundary" (C. R. Orcutt) fide Cooper; Nachoguero Valley, near California Boundary (Mexican Boundary Survey) fide Dall.

Vallonia pulchella (Müller).

Fig.: Binney, Manual, 1885, p. 77, fig. 39.

Strongly costate specimens are frequently distinguished under the name of **V. costata**, Muller. This form occurs throughout the range of **V. pulchella**, and is present in large series from almost any point. Its separation seems to be more or less arbitrary.

Upper Sonoran.

North America north of Mexico. Europe, Siberia.

Los Angeles (R. E. C. Stearns) fide Stearns; Redlands (S. S. Berry) fide Berry; near San Gorgonio Pass, San Bernardino Mountains (C. D. Voy) fide Cooper; Julian City (H. Hemphill) fide Hemphill; old gold mines, Cuyamaca Mountains (H. Hemphill) fide Cooper.

Thysanophora ingorsolli (Bland)

Fig.; **Microphysa ingorsolli** Binney, Manual, 1885, p. 170, fig. 160.

The following record, though barely on the edge of the present area, carries the southwestward distribution of this species several hundred miles beyond its known range. It may be expected to turn up at other points in the more elevated portions of the San Bernardino Mountains. (See figure 2.)

Canadian.

Colorado west to eastern Oregon (subspecies **convexior**) south to Arizona (subspecies **meridionalis**) and San Bernardino Mountains, California.

Cienaga, South Mission Cañon, three miles above forks, San Bernardino Mountains (H. Hannibal).

PUPIDAE.

Pupoides chordata (Pfeiffer).

Fig.: **Pupa chordata** Binney and Bland, L. & F. W., Shells N. Am., I, 1869, p. 241, fig. 408.

Littoral.

Coasts of Baja California and West Mexico.

San Quintin Bay, lat. 30 deg. 24 min. on salt marsh (C. R. Orcutt) fide Orcutt.

Bifidaria calamitosa Pilsbry.

Fig.: **Pupa calamitosa** Pilsbry, Naut., III, 1889, p. 61, fig. 6, 7.

Upper Sonoran.

Near San Diego (C. R. Orcutt) fide Pilsbry; *mouth of San Tomas River, lat. 31 deg. 35 min. (H. Hemphill) fide Pilsbry.

Bifidaria clementina (Sterki).

Fig.: **Pupa clementina**, Sterki, Naut. IV, 1890, p. 44, Pl. I, fig. 4.

Upper Sonoran.

*San Clemente Island (H. Hemphill) fide Sterki.

Bifidaria hemphilli (Sterki).

Fig.: **Pupa Hemphilli** Sterki, Naut., IV, 1890, p. 27, Pl. I, fig. 6.

Upper Sonoran.

San Diego (H. Hemphill) fide Sterki; *mouth of San Tomas River, lat. 31 deg. 35 min. (H. Hemphill) fide Sterki.

''Pupa orcutti Pilsbry''

Orcutt, C. R., W. Am. Scientist, 1891, p. 27.

Cooper has supposed this to be the same as **Pupoides chordata.** It does not seem to have been described.

Pupa sterkiana Pilsbry.

Fig.: Pilsbry, Proc. Phila. Acad. Nat. Sci., 1889, p. 412, Pl. XII, fig. 2, 3.

Upper Sonoran.

San Diego (C. R. Orcutt) fide Pilsbry; *Lower California, fide Pilsbry.

Vertigo californica (Rowell).

Fig.: **Pupa Californica** Binney, Manual, 1885, p. 154, fig. 140.

Upper Sonoran.

Coast Ranges of central California south to Santa Barbara Islands and northern Baja California, where several nominal subspecies are recognized as follows:

Vertigo californica catalinaria (Sterki).

Pupa californica catalinaria Sterki, Naut., IV, 1890, p. 8.

*Santa Catalina Island (H. Hemphill) fide Sterki.

Vertigo californica diegoensis (Sterki).

Pupa californica diegoensis Sterki, Naut., IV, 1890, p. 18.

*San Diego, (H. Hemphill) fide Sterki; San Ramon, lat. 30 deg. 45 min., fide Pilsbry.

Vertigo californica elongata (Sterki).

Pupa californica elongata Sterki, Naut. IV, 1890, p. 8.

*San Clemente Island, (H. Hemphill) fide Sterki.

Vertigo occidentalis Sterki.

Fig.; Sterki, Naut., XXI, 1907, p. 90, Pl. XI, fig. 5.

Pilsbry (loc. cit. p. 133) has regarded this as a subspecies of **Vertigo modesta** Say, a widespread western species in the Canadian Zone.

Canadian.

*Bluff Lake, (S. S. Berry, Miss N. G. Spaulding) fide Berry, Cienaga west of Green Valley, (S. S. Berry) fide Berry; cienaga, alt. 7,500 feet, New England Trail, San Bernardino Mountains (S. S. Berry) fide Berry.

Vertigo ovata (Say).

Fig.; Binney, Manual, 1885, p. 333, fig. 362-363.

Reported by Orcutt from San Diego south to lat. 31 deg. The species is found in Arizona and New Mexico, but its occurrence in California has not been confirmed.

Vertigo rowelli (Newcomb).

Fig.; **Pupa Rowelli** Binney, Manual, 1885, p. 156, fig. 139.

Cooper records "**Pupa**" **rowelli** and "**Comulus**" **fulvus** from the vicinity of San Gorgonio Pass, San Bernardino Mountains, collected by Voy. It is probable that **V. occidentalis** or some associated Canadian **Vertigo** was intended.

CIRCINARIDAE.

Circinaria duranti (Newcomb).

Fig.; **Macrocyclis Duranti** Binney, Manual, 1885, p. 85, fig. 49.

Syn.; **Selenites caelata** Mazyck, Proc. U. S. Nat. Mus., IX, 1886, p. 460, text figure; **Selenites Duranti catalinensis** Hemphill, Binney, III suppl. Terr. Moll. U. S., V. 1890, p. 221; IV suppl. 1892, p. 165, Pl. II, fig. 3.

Upper Sonoran.

Santa Rosa, California, south to northern Lower California.

Santa Barbara (L. G. Yates) fide Mazyck, (H. Hemphill) fide Cooper; Los Angeles (H. Hepmhill) fide Binney; *Santa

Barbara Island (J. G. Cooper) fide Newcomb, (H. Hemphill) fide Hemphill; Santa Catalina Island (H. Hemphill) fide Binney; San Clemente Island (H. Hemphill) fide Binney; San Diego (H. Hemphill) fide Hemphill; Point Abunda (H. Hemphill) fide Hemphill; San Tomas River, lat. 31 deg. 35 min. (L. G. Yates, H. Hemphill) fide Cooper.

Circinaria transfuga Hemphill.

Selenites vancouverensis var. **transfuga** Hemphill in Binney. IV Suppl. Terr. Mol. U. S., V, 1892, p. 165.

"**Selenites voyana** Newcomb" Dall (Proc. U. S. Nat. Mus., XIX, 1897, p. 375) and "**H. (vancouverensis** Lea) var. **sportella** Gould" Cooper (Zoe, III, 1892, p. 20.) appear to have been based on this species. The former was reported from El Nido (Mexican Boundary Survey), the latter from near the Mexican Boundary (C. R. Orcutt).

*San Diego (H. Hemphill) fide Hemphill, Todos Santos Bay, lat. 31 deg. 35 min. (H. Hemphill) fide Hemphill.

ZONITIDAE.

Vitrina alaskana Dall.

Fig.: **V. Pfeifferi** Binney, Manual, 1885, p. 88, fig. 53.

Syn.: Dall, Alaska, XIII, 1905, p. 37.

Canadian.

Alaska east to Colorado, south to San Bernardino Mountains, California, and Chiricahua Mountains, Arizona. "**Hyalina indentata** Say" reported by Cooper from the Sierra Laguna Range, Baja California, may prove to be the same.

Bluff Lake, San Bernardino Mountains, (S. S. Berry, Miss N. G. Spaulding) fide Berry; Cienaga west of Green Valley, San Bernardino Mountains (S. S. Berry) fide Berry.

Vitrea cellaria (Müller).

Fig.: **Zonites cellarius** Binney, Manual, 1885, p. 448, fig. 492.

Seaports and principal cities, introduced from Europe.

Upper Sonoran.

Redlands (S. S. Berry) fide Berry; Ontario (R. H. Tremper) fide Berry.

Vitrea diegoensis (Hemphill).

Fig.: **Zonites Diegoensis** Hemphill in Binney, IV Suppl. Terr. Moll. U. S., V, 1892, p. 168, Pl. III, fig. 2.

Upper Sonoran.

*4,500 feet elevation, near Julian City, Cuyamaca Mountains, (H. Hemphill) fide Hemphill.

Euconulus fulvus (Müller).

Fig.; **Zonites fulvus** Binney, Manual, 1885, p. 67, fig. 26.

Canadian.

North America north of Mexico. Europe, Asia.

Near San Gorgonio Pass, San Bernardino Mountains, (C. D. Voy) fide Cooper; Cienaga west of Green Valley, San Ber-

nardino Mountains (S. S. Berry) fide Berry; Bluff Lake Cienaga, San Bernardino Mountains (S. S. Berry, Miss N. G. Spaulding) fide Berry; Forest Home, Mill Cañon, San Bernardino Mountains (S. S. Berry) fide Berry; drift, Mill Cañon (S. S. Berry) fide Berry; cienaga, South Mission Cañon, three miles above forks (H. Hannibal).

"**Conulus chersina** Say"

Cooper, Proc. Cal. Acad. Sci., IV, 1872, p. 171.

Reported from old gold mines, Cuyamaca Mountains (H. Hemphill). The associated species are Upper Sonoran types, so it is probable that **Euconulus fulvus** was not intended. The basis of the record is uncertain.

"**Zonites**" **shepardi** Hemphill.

Hemphill in Binney, IV Suppl. Terr. Moll. U. S., V, 1892, p. 167.

Nothing further is known of this species than contained in the original diagnosis. Its reference to **Zonites** needs confirmation.

Upper Sonoran.

*Santa Catalina Island (H. Hemphill) fide Hemphill.

Zonitoides arboreus (Say)

Fig.; **Zonites arboreus** Binney, Manual, 1885, p. 61, fig. 13.

Upper Sonoran, Transitional, Canadian.

Northern Mexico to Labrador and Alaska. Japan.

Stoddard's Cañon, Ontario (R. H. Tremper) fide Berry; Redlands (S. S. Berry) fide Berry; Bluff Lake Cienaga (S. S. Berry, Miss N. G. Spaulding) fide Berry; near San Gorgonio Pass, San Bernardino Mountains (C. D. Voy) fide Cooper; near old gold mines, Cuyamaca Mountains (H. Hemphill) fide Cooper.

Zonitoides milium (Morse).

Fig.; **Zonites milium** Binney, Manual, 1885, p. 66, fig. 23.

Upper Sonoran.

Ontario and Manitoba to Florida and southern California.

Head of Bell's Cañon, Simi Hills (H. Hannibal); Redlands (S. S. Berry) fide Berry.

Zonitoides minisculus (W. G. Binney).

Fig.: **Zonites minisculus** Binney, Manual, 1885, p. 63, fig. 18.

Upper Sonoran.

Alaska to Florida and southern California.

La Brea Cañon, two miles south of Fullerton, Puente Hills (H. Hannibal); Redlands (S. S. Berry) fide Berry.

Zonitoides pugetensis Dall.

Fig.; Dall, Proc. U. S. Nat. Mus., XXIV, 1902, p. 500, Pl. XXVII, fig. 10, 12.

Transitional-Upper Sonoran.

Puget Sound region to southern California.

Ballena, Cuyamaca Mountains, fide Pilsbry.

LIMACIDAE.

Limax flavus Linné.

Fig.; Binney, Manual, 1885, p. 451. fig. 496.

Upper Sonoran.

Seaports and principal cities, introduced from Europe.

Los Angeles (Mrs. M. B. Williamson) fide Pilsbry; Redlands (S. S. Berry) fide Berry.

Limax maximus Linné.

Fig.; Binney, Manual, 1885, p. 450, fig. 495.

Upper Sonoran.

Seaports and principal cities, introduced from Europe.

Los Angeles (R. E. C. Stearns) fide Stearns; Ontario (R. H. Tremper) fide Berry; Redlands (S. A. Pease) fide Bartsch, (S. S. Berry) fide Berry; San Diego (C. R. Orcutt) fide Orcutt. (H. Hemphill) fide Stearns.

Agriolimax hemphilli (W. G. Binney).

Syn.; **Limax hemphilli** Binney, III Suppl. Terr. Moll. U. S., V, 1890, p. 205, Pl. VIII, fig. E, Pl. I, fig. 13, Pl. II, fig. 3; IV Suppl. 1892, p. 166, Pl. III, fig. 1.

Cockerell has named a var. **pictus.**

Upper Sonoran.

*Julian City, Cuyamaca Mountains (H. Hemphill) fide Binney; San Tomas, lat. 31 deg. 35 min. (H. Hemphill) fide Binney.

Amalia hewstoni (J. G. Cooper).

Fig.; **Limax hewstoni** Binney, Manual, 1885, p. 88, fig 54.

Upper Sonoran, Transitional.

Puget Sound region to northern Baja California.

Los Angeles (H. Hemphill) fide Binney; University Heights, Los Angeles (Mrs. M. B. Williamson) fide Williamson; near San Diego fide Pilsbry; ? San Tomas River, lat. 31 deg. 35 min. (H. Hemphill) fide Binney.

ARIONIDAE.

Binneya notabilis (J. G. Cooper).

Fig.; Binney, Manual, 1885, p. 108, fig. 71-74.

Upper Sonoran.

*Santa Barbara Island (J. G. Cooper) fide Cooper (H. Hemphill) fide Hemphill; fifty miles from San Quentin Bay, lat. 30 deg. 24 min. (C. R. Orcutt) fide Binney; Guadaloupe Island, lat. 29 deg. (E. Palmer) fide Binney, (W. E. Bryant) fide Cooper, (A. W. Anthony) fide Dall.

Anadenulus cockerelli (Hemphill).

Fig.; Pilsbry and Vanatta, Proc. Phila. Acad. Nat. Sci., 1878, p. 255, Pl. IX, fig. 12-14.

Upper Sonoran?

*Cuyamaca Mountains (H. Hemphill) fide Hemphill.

Ariolimax columbianus (Gould).

Fig.; Binney, Manual 1885, p. 98, fig. 58, 60.

Syn. **Ariolimax Columbianus** var. **straminea** Hemphill, Naut. IV, 1891, p. 120.

Upper Sonoran-Humid Transitional.

British Columbia to Channel Islands.

Santa Barbara (J. G. Cooper) fide Dall; El Montecito (L. G. Yates) fide Yates; Santa Cruz Island (H. Hemphill) fide Pilsbry.

ENDODONTIDAE.

Pyramidula cronkhitei (Newcomb).

Fig.; **P. (striatella** var. ?) **cronkhitei** Binney, Manual, 1885, p. 70, fig. 30.

Canadian, Transitional; reported, probably erroneously, from the Upper Sonoran.

Alaska east to Nevada, south to San Bernardino Mountains, California, and Chiricahua Mountains, Arizona.

Bluff Lake Cienaga, San Bernardino Mountains (S. S. Berry, Miss N. G. Spaulding) fide Berry.

Punctum californicum (Pilsbry).

Fig.; Pilsbry and Ferriss, Proc. Phila. Acad. Nat. Sci., 1910, p. 134, fig. 28.

Upper Sonoran, Transition, Canadian.

Coast Range, Southern Sierra Nevada, and San Bernardino Mountains, California, to Chiricahua Mountains, Arizona.

Bluff Lake Cienaga, San Bernardino Mountains (S. S. Berry, Miss N. G. Spaulding) fide Berry.

Punctum conspectum (Bland).

Fig.; **Zonites conspectus Binney**, Manual, 1885, p. 86, fig. 51.

Syn. **P. conspectum pasadenae** Pilsbry, Naut. X, 1896, p. 21.

Upper Sonoran, Transitional, Canadian.

Pasadena (D. Arnold) fide Pilsbry; Bluff Lake Cienaga, San Bernardino Mountains (S. S. Berry) fide Berry; Green Valley, San Bernardino Mountains (S. S. Berry) fide Berry; old gold mines, Cuyamaca Mountains (H. Hemphill) fide Cooper.

SUCCINEIDAE.

Succinea grosvenori (Lea).

Fig.; Binney, Manual, 1885, p. 344, fig. 372b.

Not before reported from so far to the southwest. The species has not as yet been obtained in the coastal streams, but may be expected to turn up there.

Upper Sonoran.

Great Slave Lake east to Mississippi, south to Texas, and west to Utah, Colorado, and the Salton Basin of California.

Vandeventer's Flat, head of Palm Cañon, San Jacinto Mountains (H. Hannibal).

Succinea oregonensis (Lea).

Fig.; Binney, Manual, 1885, p. 160, fig. 146.

Syn. **S. Californiensis** Crosse and Fischer, Miss. Sci., Mex. I, 1878, p. 663, Pl. XXVII, fig. 9; "**S. rusticana** Gould" Cooper, Proc. Cal. Acad. Sci., III, 1892, p. 216; **S. (rusticana** Gld. var. ?) **guadalupensis** Dall, Proc. Phila. Acad. Nat. Sci., 1900, p. 102, Pl. VIII, fig. 12; "**S. avara vermeta** Say" Hemphill, Naut., XIV, 1901, p. 125; "**S. avara** Say" Keep, W. Coast Shells, 1910, p. 295, fig. 285; not "**S. oregonensis** Lea" Berry, Naut., XXIII, 1909, p. 76 (= **S. stretchiana** Bland).

A common species in moist places.

Upper Sonoran.

Washington east to Wyoming south to southern end of Lower California.

Hope Ranch Lake, Santa Barbara (H. Hannibal); near S. P. R. R. freight depot, Santa Barbara (C. L. Lawton); Santa Rosa Island (L. G. Yates) fide Yates; Quail Lake, Tejon Pass (H. Hannibal).

Santa Barbara Islands (H. Hemphill) fide Hemphill; Compton Creek, Lynwood, Los Angeles Coastal Plain (H. Hannibal); dry swamp, Baldwin Station, Los Angeles Coastal Plain (H. Hannibal); artesian reservoir, one-half mile south of Hansen, Los Angeles Coastal Plain, (H. Hannibal); swamp, La Mirada, Los Angeles Coastal Plain (H. Hannibal); swamp, Willows, Los Angeles Coastal Plain (H. Hannibal); Ballona Creek between Inglewood and Venice, Los Angeles Coastal Plain (H. Hannibal); swamp between Palms and Cienaga, Los Angeles Coastal Plain (H. Hannibal); swamp near S. P. R. R., Westminster-La Mirada Road, Los Angeles Coastal Plain (H. Hannibal); mouth of Malibou Cañon, Santa Monica Mountains (H. Hannibal).

San Diego (H. Hemphill) fide Cooper; old gold mines, Cuyamaca Mountains (H. Hemphill) fide Cooper; University Heights, San Diego (Mrs. C. Stevens).

Near lat. 31 deg. (C. R. Orcutt) fide Orcutt; Guadaloupe Island (A. W. Anthony) fide Dall; mouth of San Tomas River, lat. 31 deg. 35 min. (H. Hemphill) fide Crosse and Fischer.

Succinea sillimani Bland.

Fig.; Binney, Manual, 1885, p. 157, fig. 141.

A fine large species shaped like a grocer's sugar-shovel.

Throughout its range it seems to be rather sporadic in occurrence. Not recorded before from this portion of California.

Upper Sonoran.

Klamath Basin, Oregon, east to Humboldt Valley, Nevada, and south to vicinity of Los Angeles, California.

Swamp near peat factory, Lynwood, Los Angeles Coastal Plain (H. Hannibal); Swamp between Palms and Cienaga, Los Angeles Coastal Plain (H. Hannibal).

Succinea stretchiana (Bland)

Fig.; Binney, Manual, 1885, p. 158, fig. 142.

Canadian, possibly extending into Transition.

Idaho, Nevada, south through the Sierra Nevadas to the San Bernardino Mountains, California.

Bluff Lake Cienaga, San Bernardino Mountains (S. S. Berry, Miss N. G. Spaulding) fide Berry; Gainer's Cienaga, San Bernardino Mountains (H. Hannibal); swamp between Bear and Baldwin Lakes, San Bernardino Mountains (H. Hannibal).

The Earliest Notes on the Natural History of California.

S. B. Parish.

The accounts which the early explorers of America have left us contain occasional observations on the animals and the plants which they saw in this strange new world. It piques the curiosity, and often baffles it, to determine what it was which they saw, and attempted to describe. The earliest notes of this kind, relating to California, which I have found, are contained in "The World Encompassed by Sir Frances Drake," published in London in 1628, and founded on the diaries of the Rev. Francis Fletcher, the chaplain of Drake's ship.

It was in September, 1578, that this valiant corsair, emerging from the Straits of Magellan, entered the Pacific Ocean, then the *mare clausum* of his Most Catholic Majesty, Philip of Spain. Some months were pleasantly spent in systematically and successfully plundering the Spanish ports and galleons, and being thus "reasonably provided" with a rich cargo, Sir Frances determined to return home by way of the "Straits of Annian," that famous northwest passage which was believed to afford an open channel to the Atlantic.

So, on the 16th of April, 1579, he sailed north from Oajaca, and early in June sighted the coast of California at a latitude concerning which there has been some difference of opinion among commentators. Probably it was near Cape Mendocino, and he followed the coast to Cape Blanco. There must have been great changes since then in the climate, if we may believe what the worthy chaplain tells us.

He gives a grievious account of the "extream and nipping coald" so great that "our meat so soon as it was remooued from the fire, would presently in a manner be frozen vp." There were moreover, "most wile, thicke, and stinking fogges euery hill being couered with snow."

It was evident that the northwest passage must be abandoned, so Drake dropped down the coast to a harbour, exactly

which one has also been a disputed question. But probably it was the bay, a little north of the Golden Gate, which now bears his name. Here he remained for some weeks, cleaning his ship's bottom, and making preparations for the homeward voyage by way of the Philippines and the Cape of Good Hope. While engaged in these operations the ship's company established themselves on shore, where they formed a most cordial friendship with the "King of the region and his subjects."

The reputation for veracity of the good chaplain has not gone unimpeached, not alone because of his account of the June severities of the climate of Northern California and Southern Oregon, but also for other reasons. Indeed his commander once in his wrath characterized him as the "lyingest knave that lived." But certainly the notes quoted below are founded on actual observations.

He tells us that there were a "multitude of a strange kind of Conies; their head and bodies in which they resemble other Conies are but small; his tayle like the tayle of a Rat, exceeding long; and his feet like the feet of a Want or moale; vnder his chinne on either side, he hath a bagge, into which he gathereth his meate, when he hath filled his belly abroad, that he may with it, either feed his young, or feed himselfe when he lists not to trauile from his burough. The people eat their bodies, and make great account of their skins, for their king's holidaies coate was made of them."

While the "tayle" and the feet in this description unmistakably indicate the California gopher, it is not unlikely, from the economic uses of which the author speaks, that he confounded this animal with the ground squirrel.

A second note which is both ethnological and botanical refers to a plant which it is impossible to identify.

Describing the costumes of the natives at a state reception, the chaplain says there were some present "having cawles coured ouer with a certaine downe, which groweth up the countrey vpon an herbe much like our letuce, which layed vpon their cawles, by no winds can be remoued. Of such estimation is this herbe amongst them, that the downe thereof is not lawful to be worne but by such persons as are about the king, and the seeds are not vsed but only in sacrifice to their gods."

These brief and imperfect notes cause us to regret that the author tells us no more of what he saw on the California coast. But the day of the trained observer had not yet come, and pieces of eight and bars of bullion were of more interest than natural history.

The Bumble Bees of Los Angeles.

A. Davidson, M. D.

Bombus fervidus. Fabr. Is the most common of all the bumble bees in the vicinity of Los Angeles. Along the shore, especially at Redondo and Balboa it is quite common. Their nests may readily be found among the rushes (Juncus) in the marshy flats along the coast. They are constructed of dry grass and mossy fragments in the usual manner of the tribe and may be hidden at the roots or shrubs or rushes or concealed in the forsaken burrows of the ground squirrel. It is impossible to explore their nests without protection for the face and hands. No matter how carefully you approach them or how gently the nest is opened, they attack one most furiously. Perhaps the frequent disturbances by hungry cattle roaming these unfruitful pastures may have developed this pugnacity for their successful existence. In the interior they are not at all common though they range inland as far as the New Mexican border.

B. sonorus Say. Is fairly common on the coast and has been collected inland through the ranges around the Mohave desert to Inyo County and at Palm Springs in the Colorado desert.

B. Californicus Smith. Most commonly found on the coast beaches and at Catalina; less frequently in the San Bernardino Mountains up to 6000 feet altitude.

B. Columbicus (Dall Torre). More common than the last with the same range in Southern California.

I found this species in the Sequoia Natl. Park, but none of B. californicus of which it is supposed to be but a variety.

Mr. T. D. Cockerell has suggested that they may be distinct species and the larger size of the males of the latter would bear this out. I have sought in vain for the nests of these two species in the endeavor to definitely determine their relative status. Personally I think they are distinct species.

B. edwardsii Cress. In the Sierra's at Sequoia Natl. Park this insect is fairly common. It is somewhat rare in the San Bernardino Mountains and our coast range. At San Fernando I found a colony warmly housed in the nest of a cactus wren. At that time, (May) it contained thirty individuals.

B. juxtus Cress. Six specimens captured at Seven Oaks and Bear Valley, San Bernardino Mountains.

B. nevadensis Cress. One specimen on Wilson's Peak.

B. morrisonii Cress. One specimen on the trail to Wilson's Peak.

Louis A. Greata.

Theodore Payne.

In the death of Louis A. Greata, which occurred at his home in this city on May 1st, the Academy of Sciences loses an old friend, and one who for many years was an active member.

Mr. Greata was born in London, England, in 1857, and was educated in Paris and New York City, later studying law in the offices of a prominent firm in San Francisco. He came to Los Angeles about twenty years ago, and for a number of years was Secretary of the Pacific Coast Hardware and Metal Association.

He was an ardent student of nature, taking up Botany as his special study. He became a member of the Academy of Sciences, and for many years he was Secretary of the Botanical section. He did much valuable work in the local field, having under his charge the Herbarium of the Academy of Sciences, and adding to it a vast number of specimens. His knowledge and deep researches in plant life won for him the recognition and friendship of many of the most noted scientists. Being a deep student of nature, and possessing a brilliant mind, he saw the most beautiful things in life. His gentle, earnest, loyal nature won for him many firm friends, and indeed he was loved by everyone who knew him. His life was full of promise until a few years ago illness rendered him unable to continue his business career or scientific studies. He is survived by a widow, a son, John B. Greata, and a daughter, Miss Maud M. Greata, of this city.

Notes on the Mimicry of Two Sesiids: Sesia Rutilans and Sesia Animosa.

F. Grinnell, Jr.

In the early part of July, 1908, in Strawberry Valley, San Jacinto Mountains, 6000 feet altitude, I collected specimens of the above-named clear-winged moths. They were observed in a rank meadow composed mainly of a rosaceus plant, the flowers of which proved to be very attractive to most all insects, especially the commoner forms of the region. From about 10 a. m. till 3 p. m. this place was literally swarming with insects of all descriptions, and a stroke with the net at **Chrysophanous Xanthoides**, which was especially common and conspicuous, would result in the capture of examples of other insect orders.

I took the first **Sesia rutilans** on July 9, and up to the middle of this month over fifty of this species and only two **animosa**.

The latter was described from Arizona and has not been hitherto reported from California, I think I saw one or two more but failed to net them. I looked carefully nearly every day in this particular meadow, and am sure I did not overlook very many of these Sesiids, so the specimens which I took represented the proportion which were flying about. Indeed, I was so intent on getting the specimens, that I did not realize the nice opportunity for observation in insect bionomics, which was before me. There were several species of bees flying very commonly in the field which resembled **rutilans** to a remarkable degree, but I did not see any that closely resembled **animosa**; this fact would agree with Wallace's third law of mimicry, viz: "that the species which resemble or 'mimic' those dominant groups are comparatively less abundant in individuals, and are often very rare." I did not pay enough attention to the bees, their comparative abundance, and the extent to which they flew with the Sesiids, but I could generally distinguish **rutilans** by **close** scrutiny, although occasionally I got a bee by mistake and also because the bees, I believe, were much commoner, and flying more or less with the **Sesiids** or vice versa. To sum up, in this particular field the bees were very common, **Sesia rutilans** were very nearly as common, while **S. animosa** which were conspicuous were exceedingly rare.

My excuse in making this short note, is to put collectors and observers on their guard, when they happen to find conditions, like the above, which are suitable, to subdue their quest for mere specimens and note the biotic relations of these insects; the numbers of the mimics and mimicked, the habits, relations, etc. I believe that conditions as I found them are not common, and I only regret that I did not realize the fine opportunity which I had for observations.

In conclusion, I will add a quotation from Wallace's Natural Selection and Tropical Nature, p. 64, which is pertinent in this connection, as follows:

"It has been so much the practice to look upon these resemblances as merely curious analogies, playing no part in the economy of nature, that we have scarcely any observations of the habits and appearance when alive of the hundreds of species of these groups in the various parts of the world, or how far they are accompanied by Hymenoptera which they specifically resemble."

Transactions of Academy.

FEBRUARY.

The regular monthly meeting of the Academy was held in Symphony Hall on February 11, 1911.

Professor Hector Alliot, Curator of the Southwest Museum, delivered an address upon "Our Archaeological Inheritance," embracing most interesting information relating to the habits, ceremonies, architecture, implements and handicrafts of the aboriginal tribes of the Channel Islands and the Coast, Arizona and New Mexico.

His discourse was illustrated by numerous and beautiful views and by fossils, excavated from the ruins of the Cliff-dwellings and the rich archaeological field of the Southwest.

Annual Meeting.

The Annual Meeting was held on May 6, 1911, in Blanchard Hall. The President gave a statement of the activities of the Academy during the past year and imparted the information that our building in Exposition Park has progressed so rapidly that it is probable we shall be able to take possession in August.

The Annual Report of the Secretary was read and ordered to be placed on file.

The following named gentlemen were elected Directors for the ensuing year, viz: Bernhard R. Baumgardt, Arthur B. Benton, Holdridge O. Collins, Anstruther Davidson, John D. Hooker, Samuel J. Keese, William H. Knight, George W. Parsons, William A. Spalding, Albert B. Ulrey, William L. Watts.

The address of the evening was delivered by Mr. B. R. Baumgardt upon "Athens and the Golden Age of Pericles."

Directors' Meeting.

Immediately after adjournment of the Annual Meeting, on May 6, 1911, the Directors elected for the year 1911-1912 were called to order and the officers were elected for the ensuing year, to-wit: William A. Spalding, President; Anstruther Davidson, First Vice-President; John D. Hooker, Second Vice-President; Samuel J. Keese, Treasurer; Holdridge O. Collins, Secretary.

Board adjourned.

JUNE.

The last meeting of the Academy for the season of 1910-1911 was held on Saturday evening, June 10, 1911, in Blanchard Hall, a large attendance being present.

In the absence of the President, Vice-President Davidson presided.

The death, at Los Angeles, on May 24, 1911, of John D. Hooker, was announced, and Mr. William H. Knight introduced a Memorial which

was unanimously adopted. (See another page of this Bulletin for a copy of this Memorial.)

The lecture of the evening was delivered by Dr. J. H. Johnson. His subject, illustrated by stereopticon views, was "Alaska, Its Topography, History, Aborigines, Flora and Mineral Wealth," the knowledge of which, obtained by the lecturer in extended journeys throughout that Territory, was imparted in a most graphic manner.

Directors' Meeting.

A duly called meeting of the Directors was held in the office of the Secretary on Wednesday, June 28, 1911, a quorum being present, and President Spalding in the Chair.

Hector Alliot was unanimously elected a Director to fill the vacancy caused by the death of John D. Hooker.

The following named gentlemen were elected members of the Academy, viz: Harold Hannibal of Stanford University; Henry Macomb Edson of Palo Alto; Edgar Halstead, Frank Monaghan and Wilhelm Schrader of Los Angeles.

William L. Watts was elected Second Vice-President.

The Secretary was instructed to engage a hall for monthly meetings of the Academy during the coming season.

Board adjourned.

HOLDRIDGE OZRO COLLINS,
Secretary.

Wanted.

Monthly numbers of Volumes III, IV, V and VI of the Bulletin, to complete files. Address the Secretary.

First National Bank of Los Angeles

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Statement of Condition of

The Farmers & Merchants National Bank

of Los Angeles

Los Angeles, California

At Close of Business, June 7th, 1911

RESOURCES

Loans and Discounts	$ 7,832,766.45
Bonds, Securities, etc.	3,524,614.27
Cash and Sight Exchange	6,380,503.21
	$17,737,883.93

LIABILITIES

Capital Stock	$ 1,500,000.00
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Southern California Academy of Sciences

VOLUME XI

Table of Contents and Index

1912

Contents of Volume XI

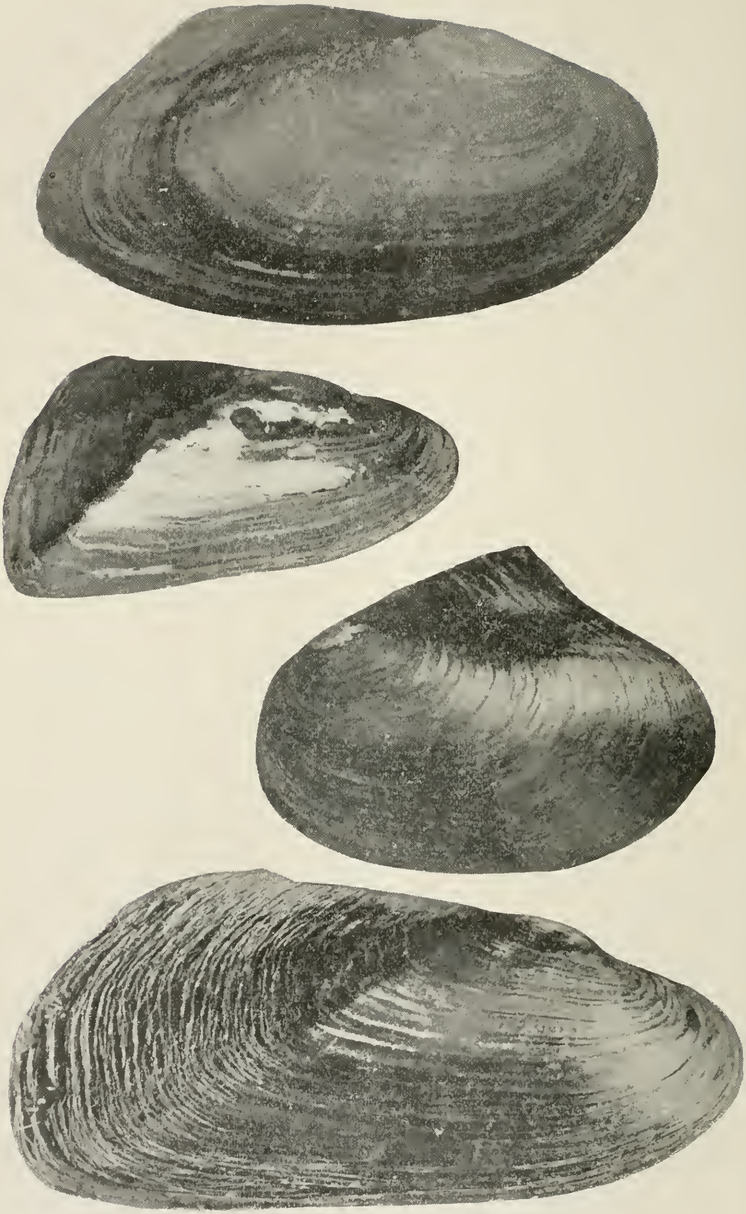
Index to Volume XI

BULLETIN

OF THE

SOUTHERN CALIFORNIA ACADEMY OF SCIENCES

LOS ANGELES, CALIFORNIA, U. S. A.
JANUARY, 1912



NAIDES OF SOUTHERN CALIFORNIA

I. ''Anodonta'' **dejecta** (Lewis)
II. **Gonidea angulata** (Lea)
III. Anodonta çygnea impura (Say)
IV. **Gonidea angulata haroldiana** (Dall)

Vol. XI. Los Angeles, January, 1912. No. 1.

BULLETIN

OF THE

Southern California Academy of Sciences

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CONTENTS:

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HOLDRIDGE OZRO COLLINS	Secretary

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Zoological Section

James Z. Gilbert, Chairman — George W. Parsons, Secretary

Botanical Section

Anstruther Davidson, Chairman

Nostra Tuebimur Ipsi

Editorial

IN this number of the Bulletin, we present an interesting paper upon Eugenics by Professor Hector Alliot, the first time this subject has been treated in a Scientific publication on the Pacific Coast.

Mr. Alliot is an Officer of the French Academy, a Professor of Technology, and he has devoted many laborious years to the study of Archaeology and explorations of the pre-historic antiquities of the Western portion of North America, his labors in this field having been partially rewarded by the degree of Doctor of Science.

The old name of Stirpiculture, while it included the human race, was more generally applied to the production of better breeds of domestic animals; but this word has been superseded by the modern name of Eugenics, which has taken rank as a Science, dealing with conditions which tend to elevate and perpetuate the physical standard of the race.

The Science of Eugenics was founded by Sir Francis Galton, who established a Fellowship of Eugenics in the University of London. The Science however has advanced but little beyond the publication of some fugitive articles relating to the surely known laws of heredity, and we consider this paper of Prof. Alliot, a valuable addition to this branch of the Sciences.

In 1871 the Italian Government under Victor Emanuel II took possession of the Collegio Romano, a group of noble buildings covering an entire square, called an Isola, or island, then conducted by the Jesuits, and converted it into a Lyceum, the Jesuits being expelled from the property, with the exception of the large Church of St. Ignatius which is located on one corner. It was from the Astronomical Observatory, located on the ponderous piers of this church, that the Jesuit, Father Secchi made his observations and pursued his studies. He

alone, of his order was allowed to remain in possession, and here he devoted himself to his Astronomical labors until his death in 1878, when the Observatory was placed under the direction of a Government Astronomer.

Soon after the death of Secchi, Pope Leo XIII took measures to establish another Observatory, which would be under control of the Vatican, and he secured the services of Prof. P. Giovanni Hagen, S.J., an eminent German astronomer and placed him in possession of the three Domes on the summit of the great wall surrounding the gardens of the Vatican, but the disturbed condition of the social, military and municipal affairs of Rome during the later years of his Pontificate, prevented his seeing a fruition of his design for a satisfactory Astronomical establishment.

His successor, Pope Pius X, almost immediately after his accession, took hold of this work most earnestly and zealously, and under his generous aid and encouragement, Prof. Hagen has been enabled to fit up these Domes with suitable instruments for various branches of Astronomical study, and in the largest—the center Dome—he has mounted and equipped with the latest improvements, an equatorial refractor of 16 inches, which was manufactured at Munich.

In June, 1910, Prof. Hagen was elected an Honorary member of this Academy, and we have just been favored by him with the gift of the first three volumes issued by the Vatican Observatory since his appointment as Director.

These publications are of the most elaborate character, and beautiful examples of the printer's art, containing many plates in line engraving and photography. They are printed in French, the first two numbers, treating upon the rotation of the Earth with a history of the Ancient and modern proofs, and an appendix relating to the publications of Prof. H. Kamerlingh Onnes of Leiden. The third number is peculiarly interesting in that the author, Father J. Stein, a Jesuit Priest, takes up the cudgels and strikes some heavy blows at the statement, which has become a belief to many, that Pope Calixtus III (Alfonso Borgia), in 1456 hurled the thunderbolts of the Vatican against Halley's Comet which was supposed to be an advance courier of calamities menaced to Christianity by the Turks, or as the author puts it in his Introduction:

"On a répété à saiété que dans le bue de détourner de la chrétienté, alors menacée par les Turcs, les calamités dont le brilliant météore était l'avant-coureur, le pape Calixte III avait lancé contre l'astre perturbatur les foudres du Vatican. Il n'est pas rare de rencountrer cette fable, toute ridicule qu'elle est, dans les auteurs les plus sérieux, et, chose etrange, jusque dans les ouvrages de science."

We welcome these publications with the hope that we will be favored with all future publications by the Vatican Observatory.

Our Board of Directors has adopted measures for acquiring a permanent publication endowment whereby the Bulletin may be published quarterly.

This endowment fund will be secured by obtaining Life Memberships, the fee for which is the sum of One Hundred Dollars. All sums realized from this source, will be invested in safe, six per cent securities, the interest of which will be applied for the expenses of the Bulletin.

We are glad to be able to announce that this project has met with favor among our members and that its success is assured. The following persons subscribed to this fund and asked to be placed on the roll of Life Members, which exempts them from all future payments, viz: William H. Avery, Arthur B. Benton, H. M. Bishop, M.D., Norman Bridge, M.D., W. A. Cheney, J. Ross Clark, F. M. Coulter, James Cuzner, Anstruther Davidson, M.D., Myra Hershey, Samuel J. Keese, James B. Lankershim, Homer Laughlin, Jr., W. C. Patterson, Frank X. Pfaffinger, Mrs. G. S. Safford, William A. Spalding, John S. Vosburg.

The Board desires to increase this endowment to Three Thousand Dollars, and the Secretary will be pleased to receive the names of others willing to be added to the class of Life Members.

The fixtures and furniture for our large exhibition room in the new Museum Building are in rapid progress of completion, and we expect to commence the arranging and placing of our valuable collections for inspection at an early future. Messrs. Jewett and Fischer are very busily at work mounting the fossils from La Brea Rancho and when the stands, cases, drawers and desks shall be in place, many complete skeletons, large and small, will be ready for their final resting place, a source of wonder for the curious and of study for the Scientist.

Holdridge Ozro Collins.

Wanted

Monthly numbers of Volumes III, IV, V and VI of the Bulletin, to complete files. Address the Secretary.

Primitive Eugenics.

Hector Alliot, Sc.D.

While science has for many years been giving to the world marvelous new vegetables and fruits, evolved for the most part from insignificant stock, it is very recently that attention has been directed toward the systematic improvement of the children of men.

In a comparatively brief time the potato (solanum tuberosum of the botanist) an almost wild small tuber cultivated by the Incas of Peru and unknown to the rest of the world, was transformed into the generous sized palatable vegetable that has become the food of millions. In his "Cronica de Peru", written in 1553, Pedro Cieca predicted that the potato would prove to be "optimum Benigni Numinis donum pauperi panis" (the greatest gift of the Beneficient Almighty, the bread of the poor) but picture his astonishment could he behold the potato of today, known and used in every part of the civilized world. We have devoted infinite time and care toward the improvement of animal and vegetable species according to our needs, at the same time we have been singularly neglectful of all efforts tending toward the scientific betterment of man himself. Is it not time that this new science of eugenics (the well born) should engage our interest?

Difficulties attend the consideration of the subject, however, which—in our present conception of the marriage relations—would appear almost insurmountable. To procreate and bring up children possessing certain well determined attributes has been the aim and achievement of many aboriginal tribes, and an insight into their mode of procedure may prove enlightening.

On the American continent a striking example of the efficiency of primitive eugenics is found among the Seri Indians, a tribe of the west coast of Mexico, little known except to ethnological investigators. The rational system of eugenics as evolved by the untutored Seri is practically the same as that employed by other native races of Asia and Africa. In the case of the Seri, however, we have a typical method maintaining itself longer perhaps than among any other group of individuals, owing no doubt to the rigid and significant requirements of the system.

The center of the district which may be called Seri-land is approximately the intersection of parallel 29° with the meridian 112°. Half of this lies on the mainland, the other half

on the Isla Tiburon, which is separated from the desert coast of Mexico by "El Infiernillo" (The Little Hell). According to Bandelier, Nunez Cabeza de Vaca first approached Seri-land in April 1536, Fray Pedro Nadal and Fray Juan de la Asuncion in 1538, followed by the expedition of Marcos de Niza. Then came the "Right Worshipful Knight Francis de Ulla, borne in the city of Medina", and numerous other expeditions, most important of which was that of Father Kino, who in 1702 brought out a wonderful map of the region with his own curious names of various places, among them being "Islas de sal, si puedes" (Islands get out if can'st). All these explorers agree in depicting the land as arid and forbidding, this being later confirmed by the records of the Jesuits, and the Franciscan fathers unsuccessful attempts to enter Seri-land in 1772.

It is only within recent years that the natives have ascended in the scale of civilization to the condition of husbandry; they remain nomadic and uncultured. Their utensils and weapons are of the crudest forms. The struggle for existence on the dangerous shores of the Infiernillo, the crossing of its turbulent waters, call for extraordinary skill in the fishermen; the pursuit of game over the arid wastes of Seri-land requires great fleetness of foot, ability to carry burdens, and unusual powers of endurance without food or drink. Recognition of these indispensable and necessary characteristics, and that they might readily be lost by too close mixture of consanguinity have gradually evolved into the eugenic law of the Seris.

Seri Marriages.

The Seri are monagamous. Marriage with them is the most sacred of institutions, and few—if any—devote more thought and care to primary mating than these natives, unless it be the Australian aborigines. This serves to confirm the fact that the insular condition of existence, segregating certain groups from blood contamination of neighbors, is the most ideal condition for the development of eugenics. In rearing improved strains of domestic animals we have artificially created an "insular" condition by rigid segregation of individuals and the selection of suitable mates. Tiburon Island is to the Seri what the cage is to the bird. Nature has surrounded his domain with such physical obstacles that he has been able to practice undisturbed for centuries his system of evolutionary eugenics and achieved very remarkable results. Thus demonstrating that under certain conditions man could be improved by the same methods he himself employs in the betterment of animal and vegetable species.

The requirements necessary to a Seri union are always determined by the relatives of the suitor, who rigidly scrutinize whether the relationship existing between the two considering matrimony is such as to meet with the strenuous laws

of exogomy and clan relations; they also investigate the health of both candidates and whether or not they have attained a suitable age.

The young man must have been received into the warrior class to have reached a marriageable age. He cannot contract a union within his own clan, but must seek a bride outside, all maidens beyond a certain age being eligible provided they meet the other necessary requirements. On the other hand the condition of the maiden is given extreme care and attention. She cannot be united to a youth of her own totem. One year or often two must have elapsed between the great public festival of her puberty and her betrothal, and she must be of perfect physical development and health.

Proposal and Probation.

First a proposal is made to the head matron of the maiden's clan. She receives it and later discusses it with the matrons of her totem. Should they accept it favorably, such action is only conditional, as it must come for adjudication before a council of women from the clans of both candidates, who decide the case finally. During this period of deliberation the young woman is the object of many flattering attentions from the young people of both tribes, and is presented usually with the much esteemed symbolical robe of pelican feathers, emblematic of fruitful motherhood.

When the betrothal is finally agreed upon by the matrons the prospective bridegroom leaves his own clan and allies himself to that of his betrothed. He then enters upon a most extraordinary period of probationary marriage. Various requirements must be complied with by him during this period. He must show bravery in warfare, skill in fishing and the chase, and display other physical qualifications of manhood. He thus becomes the object of keen scrutiny, and he must demonstrate to all concerned that he will prove a competent protector and provider not only for his bride but for her family and the dependents of his adopted clan that may need his aid. This trial period continues for one solar year. During this time the young man inhabits the "jacal" (hut) of the bride and shares the robe of pelican feathers, but only as a protector never as a privileged spouse.

The bride to be meanwhile assumes a position most important. She is admired and feasted by the men of both clans, and for one whole year of her life is exalted to a station that is only a little less authoritative than that of a chief. At the end of the year, however, should the young man have met with final acceptance as a suitable mate, he enters the jacal as master and the bride—shorn of her brief authority—takes her place among the matrons of the clan and enters upon the dull routine of primitive marital existence.

Both parties being of perfect health and strength the birth of children—so keenly desired by most aborigines—is among the Seri cause of great rejoicing; yet twins are not regarded with favor and the birth of triplets is considered monstrous and the mother is generally put to death.

The significant character of these monagamous unions—which seem to remain permanent—the absence of purchase price and dowry, and the probationary marriage are remarkable features rarely met with elsewhere among aborigines. It is only among some of the Australian native tribes and the Patawats of California that the practive of "half marriages" prevails, and these also exclude the purchase, capture and elopement features so generally a part of primitive unions.

Eugenic Result.

Through an original desire to propitiate mystical deities gradually evolving into tribal customs and laws, the Seri has by long centuries of practice reached a plane of typical ethnogamy. By circumscribing the matrimonial selection and consummation he has produced one of the most perfect examples of tribe-sense. By continuous observance without exception of certain rules the race has gained wonderful attributes in the assemblage of units artificially produced to meet the exigencies of their difficult existence; there has constantly been developed stronger, fleeter footed men and women capable of bearing heavier burdens, physical features best calculated to assist the growth and maintenance of the tribe.

Since this has been the Seri ideal by the strict supervision of the union, which is continued in the rearing of the children, he has attained the desired results. He has produced a type of men six feet and over in height, women from five feet eight to six feet; erect, of easy carriage, with broad deep chests, limbs remarkably slender if often out of proportion, large feet, and a luxuriant growth of long hair. The endurance of the race is extraordinary, its fleetness of foot almost beyond belief and its fishing ability without parallel. Besides his moral attributes are equally unusual. The Seri has such an antipathy for aliens that the sight of one produces upon him the same effect that the sight of a wolf does upon a dog—his hair rises in anger, as has often been observed. It is only upon rare occasions that a Seri has been captured alive, for in a physical reflex action of a mental attitude superinduced by centuries of practice, he prefers to die rather than look upon an alien's face; his valor and resistance have never been surpassed.

Thus the ideal of a people, suitably located upon an island which by its very inaccessibility offered the best condition for the development and retention of customs, has been fully

realized on both the physical and moral plane by a rigid adherance to primitive yet fundamental eugenic laws.

It is evident that any other ideal of physical or mental endowments might be similarly attained. Unfortunately our present civilization does not look with favor upon the sacrifice of individual preference in matrimonial unions to the good of the commonwealth, so that Seri practices are scarcely applicable today. We have, however, the compromise of compelling a scientific study of the unfit and a barring from matrimonial union all those who are recognized as being incapable of procreating healthy and normal descendants.

References: Besides the illuminating work of W. J. McGee on the Seri Indians (Bureau of Am. Ethnology, Vol. XVIII, Part I), which includes practically all the most authoritative knowledge we have regarding these aborigines, and which has been used largely here, the following publications may be of value in the study of special features of the subject: Am. Anthropologist, The Beginning of Marriage, 1896, Vol. IX; Arricivita, Fray Juan Domingo, Cronica Serofica y Apostolica, etc., Mexico, 1792; Bancroft, Hubert Howe, History of North Mexican States, Vol. XV; Bandelier. A. F., Magazine of Western History, Vol. IV, 1886; Frazer, J. G., Totemism and Exogamy; Hittell, Theo. H., History of California, Vol. I, P. 43; Hovelacque et Herve, Precis d'Anthropologie; Venegas, Miguel, Natural and Civil History of California, trans. London, 1756.

The Protective Coloration in the Gold-fish.

Wilhelm Schrader.

I am employed as gardener at the California Hospital in Los Angeles. About six years ago I constructed a little fountain with cement waterbasin, surrounded with ferns and rockwork. To make it a little lively I stocked it with two dozen goldfish, and expected to see the family soon grow larger; but as the water is only a foot deep and very clear, the fish could find no place in which to hide; and as our company employs about one hundred nurses, and everybody likes to watch the fish, it seems they were a little timid; for some reason the fish family did not increase.

In the course of time the water plants grew larger and partly covered the water; also certain algal growths started on the cement bottom, and this afforded hiding places, as nature makes them, and the goldfish now seemed to be at home.

It is a known scientific fact, that when fish are kept for a long time in comparative darkness, they are able to change to a darker color, but I have never heard that a goldfish was able to change the bright golden yellow color completely to a darker one like a carp, so that not one yellow scale is left. I think this came about, while two of my goldfish were, during the spawning period, a long time in a dark, shady place, and

found it for their well being to adopt a protective dark color. It is not known to me that all goldfish adopt a dark color during the spawning time; however, what is interesting is the fact that all the little young fish,—I have counted eleven from this dark mother fish,—have the same dark color, and now that they are about two months old, some of this coloring begins on the head and on the belly to change to yellow, and one of them is now almost yellow. As goldfish like to swim in well lighted places, even when they have their choice, I believe they will all change in time to golden yellow, like their father; however, I am not sure about the true father, as there are two large dark ones.

When a color is protective, a goldfish, which likes to swim near the surface in the sunshine, will certainly obtain more respect from its enemies than when it had a dark color; this golden yellow is a rare color, and consequently a protective fright-color. I wish to point here to the published statement, which I accept as true, that all fish have a protective color. Many people wonder why it is that all fish have the underside lighter than the upper side. Both sides have protective color in the following manner: When a fish swims in the water, all other fish, animals, or men, that are above, and look down, will see a dark background, no matter how clear the water is, and this fish upon which you look, will show you only the dark back, and is by this dark color, in some degree protected. On the contrary, all enemies which are deeper in the water and look upwards, will see a light background, and will see only the under side of the fish, and in this way the light colored underside will be the protective one. You may think, if this is true, why is it that a very big fish of prey is colored in the same way? Well, a big fellow has to use his protective color to make a living. If it had no protective color, all the little fish would see the danger in time, and the big fellow would soon starve to death.

Botanizing in Inyo County.

A. Davidson, M. D.

My annual July holiday and botanizing trip, for the two are combined, were spent at Andrew's Camp on Bishop Creek sixteen miles from the town of Bishop, in Inyo County.

When the S.P. railroad from Mohave is broadguaged all the way to Reno, the eastern slope of the Sierras, the trout-laden streams of Cottonwood Creek, Bishop Creek and Owens River with their numerous lakes will become the Mecca of all the Waltonians of our district. Then one can leave Los Angeles at night and before noon of the next day have fished his noon day meal in the Sierras at 7-8000 feet altitude.

At present the railway facilities are not alluring. From Mohave northward the aqueduct train, a combination of cattle truck and day coach, shuffles itself along the sunbaked trail at about ten miles an hour. At every siding the wearisome switchings suggest a rehearsel for a better future. As the fare is five cents a mile, one feels he is being taxed on the unearned increment of the scenery, but the latter is worth the price. The steep, turreted front of 100 miles of Sierra, once wreathed and completely mantled with winter snow, now fast disappearing, still showed vast snow fields and glaciers that make this seem a panorama of sublime beauty and rugged grandeur that can scarcely be excelled in any country.

The broad guage ends at Owenyo. The one and only habitation, the "hotel," (a line of box cars) with clean comfortable beds, is the resting place for the night—if they are not all occupied. If they are the sand outside is clean, the desert air is glorious, and you are to be congratulated if mother earth is your hostess.

About midday we reached Laws, staged to Bishop and spent the remainder of that day and the following exploring Bishop.

Bishop stands on what was once the tule-covered cienega through which Bishop Creek filtered its way to join Owens River and thence to Owen's Lake. Its soil in consequence is a peat rich in all that makes to fertility.

The whole district is exceedingly fertile but at present it is irrigated to such an excess that the natural herbage has been almost wholly supplanted by immigrant weeds and sedges. Among the latter is the troublesome "taboos" a tuberous-bearing carex that threatens to dispossess everything.

Most prominent among the immigrant plants is the Sweet Clover, melilotus alba—which borders the roadways in dense masses. Its prevalance here is ascribed to the intentional broadcast sowing of the seed by "thoughtful" bee keepers.

The wild lettuce (Lactuca scariola), dandelions, red, white, and yellow clovers, and various foreign grasses are found in abundance. Among the latter was Holcus lanatus (Yorkshire Fog) the pest of British pastures. So far the plants are not numerous, but it will be interesting to observe its behavior on Californian soil.

A 16-mile stage ride up the river, on a good road, brings us across the main stream and a short distance up the south fork, finds as at Andrews' camp at 8000 ft. alt. with good tents and all needful comforts. This valley, narrow and deep, extends for about twelve miles behind the Sierras and terminates at the divide about six miles from one of the sources of Kings River. The stream is small, 10-15 feet wide about 2 feet deep, fairly rapid, ice cold, and alive with fish.

Its edges are bordered with a continuous line of willow Salix lemmoni, birch (B. fontanalis) and cotton wood P. trichocarpa, and a few large pines P. ponderosa. The valley on each side is grey with sage brush (artemesia tridentata) brightened by patches of blue (Lupines) yellow (Eriogonium) scarlet pentstemons and castilleias, and a gilia of wonderful coral hues, or starred with clumps of Gilia pungens and Phlox longituba.

In the twilight the latter unfolds its petals and difuses its fragrance, while the Phlox which has similarly saluted the day closes. On the Mohave Desert the Gilia Parryi similarly rules the day and G. dichotoma the night.

Six miles up stream the Cal. Nevada Power Co. has just completed a dam. Here limber pine and tamarack possess the slopes, the aspen replaces the cottonwood and S. geyeriana argentea represents the willow. Here too was my first view of Ledum glandulosm, gorgeous white columbines, various saxifrages, arnicas, pentstemons, etc. The meadows bordering the stream are practically beds of iris shooting stars, scarlet columbine, aconite, polemonium and asters such as are to be found elsewhere throughout the Sierras.

The shrubs bordering the meadows near the camp were chiefly Purshia tridentata, Symphoricarpus longiflorus; Prunus Andersonii (called wild peaches by the children) currants, gooseberry and ceanothus. A coral pink variety of Gilia aggregata, a beautiful plant was the most conspicuous plant in this locality. Higher up it was supplanted by Gilia bridgesii.

Near camp is a power dam full of large but wary trout ten or twelve inches on the average. If you are used in the ways of the species you may come home with some silvery scaled beauties bright as salmon fresh run from the sea. If not, pass on, there are plenty trout all the way to Lake Sabrina, six miles above.

Pinus ponderosa, tamarack and cottonwood are more abundant and of larger growth here. Ceanothus velutina was here discovered. Arabis davidsonii, Greene, a new species, was

picked from the crevices of a rock on which I sat as I fished out half a dozen trout that were—well, you must allow something for the altitude and the traditional fisherman?

On the roadside near Lake Sabrina another new Arabis, inamoena, Greene was found in abundance in the shade of some large boulders.

Mine host of the mountains is ever anxious to enhance his guests' enjoyment. To their inquiries, 'are there any rattle snakes' the invariable rejoinder is, 'there are none or well there are probably a few but I have seen none for many years now.' Here there really are no rattlers only a few water snakes. Why this should be so I cannot explain. We have met rattlers in practically every mountain resort in southern California from 11000 feet altitude downwards.

Animal life is here abundant. Ground squirrels, chipmunks and mice of various species are very common. The ground hog is not rare, deer and mountain sheep not infrequent.

Some forms of insect life are very abundant. Among the bees the genus Osmia had the largest representation and the Bombidae the smallest. A small beetle of the genus Dorytomus was so abundant that at times only continuous vigilance prevented one from making a meal of them. In the evening these beetles could be found streaming, like a colony of ants, up the boles of the cottonwood trees to their evening roosts. Ticks (Dermacentor occidentalis) of the same species we have in the vicinity of Los Angeles are very abundant in the sage brush, and not a few were to be found in the clothing after each excursion. They were slow to penetrate the skin, and unlike our home species caused no pain when they attached themselves. The cattle seem to be comparatively free from them.

Bird life was abundant. Nests of the western Robin and white crowned sparrow were not uncommon. One of the latter with six eggs I gathered for the museum. A few grouse were seen with their young. A flock of Belding's blackbird chattered around the camp.

Of the plants collected the following are perhaps worthy of mention: Erigeron concinnus aphanactis Gray, Erigeron armeriaefolius Turcz, Erigeron salsuginosus Gray, Solidago elongata Nutt, Crepis Andersonii Gray, Arnica nevadensis Gray, Haplopappus apargioides Gray, Arnica Chamissonis Less, Helenium Hoopesii Gray, Aster Fremonti Gray, Aster adscendens Lindl, Botrychium simplex Hitch, Pellea breweri Eat, Parnassia palustris L, Edwinia californica Small, Allum validum Nutt, Silene menziesii Hook, Tilimia tenella Nutt, Geum strictum Ait, Fragaria truncata Ryd, Acrolasia davidsonii Abrams, Acrolasia veitchiana Kell, Castilleia montana Congdon, Salix mackenziana Barr, Salix californica Bebb, Salix seouleriana Barr.

To Messrs H. M. Hall, P. C. Standley, and Carleton Ball I am indebted for identification of doubtful species.

The Aquatic Molluscs of Southern California and Adjacent Regions, A Transition Fauna.

Constituting Part II of "A Census of the Land and Fresh-water Mollusks of South-western California."*

Harold Hannibal.

GENERAL REMARKS.

The term "Californian Province" was introduced by Woodward† to embrace the portion of North America lying north of Mexico and west of the Rocky Mountains, distinguished by a peculiar fauna of land and fresh-water mollusks. It was subsequently recognized by Tryon, Fischer, and Cooke in their more recent manuals and is now generally accepted, constituting the western portion of the Nearctic Region. The first writer to attempt a subdivision of this extensive area into convenient sub-units was Dall‡ who recognized in the region from the Columbia Basin northward three "systems" or faunules. In 1910, the writer after a study of nearly all the available records extended this classification to the less boreal portions of the Province lying within the United States. Additional study has shown the necessity of modifying these divisions somewhat, due to unreliable records, but in the main the conclusions reached in "West Coast Shells" have proven well founded.

From these Systems the writer has selected two, the **Los Angeles**, embracing with one or two exceptions to be noted later, the Pacific drainage from Point Conception, California, to the vicinity of San Sebastian Viscaino Bay, Baja California, and the **Arizona**, including the catchment area of the Colorado River below The Needles or thereabouts, the drainless basin of the Salton Sea, and the desert region about the head of the Gulf of California, as a subject for special study, no less on account of the local interest which this region holds to the numerous southern Californian conchologists than that it con-

*The removal of the writer from Stanford University to the Washington State Museum before the completion of the manuscripts of the summary and additions to the landshell fauna which were to have found a place in the following pages has necessitated their omission at this time. The scope of the present part has been enlarged somewhat to embrace the fauna of the lower Colorado Basin, and the article is complete in itself. A discussion of relationships, additional records, and the accompanying bibliography of the landshell fauna may appear in the future as Part III.

†Manual of the Mollusca, 1856, III, map facing title page.

‡Pop. Sci. Mo. LXVI, 1905, 362; Alaska XIII, 1905, 2.

tains a fauna transitional in facies between that typical of the California Province proper on one hand and that of the Mexican Province on the other, and is therefore an excellent example of the resultant of the mingling of two dissimilar units.

SYNOPSIS OF SPECIES.*

*References marked with an asterisk refer to figures, records to the original locality.

UNIONIDAE.

Anodonta cygnea (Linné.)

Mytilus cygneus Linné. Sys. Nat. (10 ed.), 1758, I, 706; **Anodonta Oregonensis** Lea. Trans. Am. Phil. Soc. VI. 1838. 80. Pl. XXI, 67; ***A. cygnea** Hannibal, W. Coast Shells, 1910. 302. Pl. II, 7.

The region under discussion is several hundred miles south of the existing range of typical **Anodonta cygnea**. The species is found, however, in an artificial pond in one of the Los Angeles parks, whither it was doubtless introduced in the glochidium stage on fish from Oregon or Washington, some years ago. The record is an interesting one since it illustrates the chief mode of distribution of this group.

All Europe, Siberia; Pacific drainage of North America south to latitude of Mount Shasta, California, infrequently in Great Basin and middle California.

Los Angeles System: artificial pond, Eastlake Park, Los Angeles (H. Hemphill) fide Keep. (H Hannibal).

Anodonta cygnea impura (Say). Fig. III.

Anodonta impura Say. New Harm. Diss. II. 1829, 355; **A. Nuttalliana** Lea Trans. Am. Phil. Soc. VI. 77, Pl. XX, 64; **A. Wahlamatensis** Lea, loc. cit. 1838, 78, Pl. XX; 64; **A. Californiensis** Lea, Trans. Am. Phil. Soc. X, 1852, 286, Pl. XXV, 47; **A. cygnea impura** Hannibal, W. Coast Shells, 1910, 303 (fig. not typical).

This well known Naiad, locally common in the few perennial streams and ponds of southern California, has passed in the literature under a variety of names, all of which have been duly considered and the earliest, applied by the father of American conchology, Thomas Say, to specimens which he obtained from the suburbs of Mexico City while on a horseback trip to that then conchological **terra incognita** in the early years of the last century, has been retained in the new edition of West Coast Shells.

It is unfortunate that the records of **Anodonta** from southern California are few. The draining of ponds and lagoons and the use of river waters for irrigation so threaten to exterminate it that in a few years it will be almost impossible to obtain an adequate idea of its former distribution.

Mr. Frank Stephens of San Diego informs the writer that this mollusk has appeared in abundance about one of the islands in the Salton Sea since the overflow of the Colorado River into that former desert basin.

Mountain regions of southern Mexico north in the Pacific drainage and Great Basin to southern Oregon, less frequently in Columbia basin, where it intergrades with **cygnea.**

Los Angeles System: (extinct) swamp between Palms and Cienaga, Los Angeles Coastal plain (H. Hannibal); artificial pond, Elysian Park Los Angeles (Mrs. T. S. Oldroyd); reservoir north of old S.P.R.R. depot, east side of Los Angeles River, Los Angeles (R. E. C. Stearns); (extinct) Nigger Slough, Gardena (H. Hannibal); (extinct) pond, Country Club grounds, Long Beach (fide H. Lowe); Rio Honda, Savannah (R. E. C. Stearns).

Chino Creek, seven miles south-west of Ontario, San Bernardino Valley (R. H. Tremper) fide Berry.

Creek near Fallbrook, San Diego Mesa (fide C. A. Waring).

Arizona System: (semifossil) Indio, Colorado Desert (R. E. C. Stearns) fide Stearns, (H. Hemphill), (H. Hannibal); (semifossil) playa south of mouth of Roark Cañon (S. Bowers) fide Bowers; (semifossil) Monument 219, International Boundary (E. A. Mearns) fide Simpson; (semifossil) New River, Laguna (E. A. Mearns) fide Simpson; (semifossil) Laguna Maquata, Baja California (C. R. Orcutt) fide Orcutt.

Lower Colorado River (J. LeConte) fide Lea; Oak Creek, Arizona (E. H. Ashmun).

"Anodonta" dejecta Lewis Fig I.

Anodonta dejecta Lewis, Field and Forest, I, 1875, 26; in Yarrow, Rept. Geol. and Geog. Sur. W. 100 Mer. V, 1875, 952; **A. mearnsiana** Simpson, Naut. VI, 1893, 135.

This Naiad, while agreeing with **Anodonta** in the absence of hinge teeth, is very different in other respects and belongs to a genus by itself, to be properly diagnosed and named elsewhere.

Arizona System: (semifossil) New River, Laguna, Colorado Desert (E. A. Mearns) fide Simpson.

Ponds, Tucson, Arizona (E. A. Mearns) fide Simpson; Santa Cruz River, Tucson, E. A. Mearns) fide Simpson, (J. F. James) fide Stearns;* San Bernardino Rancho, International Boundary (E. A. Mearns) fide Simpson; San Bernardino River, International Boundary (E. A. Mearns) fide Simpson; Colorado River, International Boundary (E. A. Mearns) fide Simpson; mouth of Colorado River, Mexico (E. A. Mearns) fide Simpson.

Gonidea angulata (Lea) Fig II.

Anodonta angulata Lea, Trans. Am. Phil. Soc. VI, 1838, 97, Pl. XVI, 52; **Gonidea angulata** Hannibal, W. Coast Shells, 1910, 304, fig. 289.

Typical **G. angulata** and its ssp. **haroldiana** occupy the same geographic area, both burrow into clay banks or bottoms of streams, but **angulata** is found only in rapid streams, whereas **haroldiana** should be looked for in sluggish waters (but not lakes). Both may be expected to turn up at various points in southern California when intelligently sought for.

Confined to the streams flowing into the Pacific Ocean, from the Fraser Valley, British Columbia, to southern California.

Los Angeles System: Los Angeles River (R. E. C. Stearns) fide Dall.

Gonidea angulata haroldiana Dall. Fig. IV.

Anodonta angulata var. **subangulata** Hemphill, Zoe. I, 1891, 325, Pl. X, 1-2; not **Anodon**(ta) **subangulata** Anthony, 1865; **Gonidea angulata** var. **haroldiana** Dall, Smith. Misc. Coll. L, 1908, 499.

The specimen figured is one of the cotypes in the writer's collection and is somewhat more finely developed than usual. It might be noted that the original specimens of this subspecies were actually obtained from the Coyote Creek between San José and San Francisco Bay, not the Guadeloupe Creek, as recorded by Dall through a misunderstanding. **Gonidea** formerly occurred in the latter stream but was destroyed by sewage some years ago.

To Dr. Tremper is due the credit of extending the range of this variety to southern California.

Los Angeles System: Chino Creek, seven miles south-west of Ontario, San Bernardino Valley (R. H. Tremper.)

SPHAERIDAE.

Sphaerium simile (Say).

Cyclas similis Say, Nich. Encyc. (1Ed.) II, 1817, Pl. I, 9; **C. striatina** Lamarck, An. Sans. Vert. V, 1818, 560; **C. dentata** Haldeman, Proc. Phila. Acad. Sci., 1841, 100; **C. solidula** Prime, Proc. Bos. Soc. Nat. Hist. IV, 1851, 158; **C. nobilis** Gould, Proc. Bos. Soc. Nat. Hist. V, 1855, 229; ***Sphaerium striatinum** Prime, Mon. Am. Corbic. 1865, 37, fig. 29; ***S. dentatum** Hannibal, W. Coast Shells 1910, 305, Pl. II, 5; not **S.** "**simile** Say" Baker. Chic. Moll. II, 1902, 116, Pl. XXVII, 3.= **S. sulcatum** Lam.

A widespread polymorphic species variously and often incorrectly identified.

The Arizona records while near the southern limit of its range are doubtless authentic. That from San Pedro, California, requires verification.

North America generally south to Alabama, Arizona, and middle California.

Los Angeles System: San Pedro (T. H. Webb) fide Gould.

Arizona System: (semifossil) Colorado Desert (W. P. Blake) fide Gould.

Colorado River, Yuma, fide Cooper; San Bernardino River (E. A. Mearns) fide Dall.

CORNEOCYCLADIDAE.

Corneocyclas compressa (Prime).

Pisidium compressum Prime, Proc. Bos. Soc. Nat. Hist. IV, 1851, 164; *Mon. Am. Corbic., 1865, 64, fig. 67; ***P. compressum** Hannibal, W. Coast Shells, 1910, 306, Pl. I, 2.

Dall (Tr. Wagn. Inst. III, 4, 1903, p. 1439-60) has shown that **Corneocyclas** is the proper name to use for this group of the old genus **Pisidium.**

C. compressa is decidedly sporadic in occurrence in the present region, due to the general absence of lakes, its most frequent habitat.

All North America south to Mexico, into which it extends but a short distance.

Los Angeles System: Ventura County (H. Hemphill) fide Dall.

Arizona System: San Bernardino River, Arizona (E. A. Mearns) fide Dall.

Corneocyclas pulchella (Jenys).

The English name **pulchella** of Jenys, a clergyman noted for his studies among these small bivalves, takes priority over the familiar American **abdita** by some nine years. The species may have been named even earlier on the Continent but the European Corneocyclades are imperfectly known. Through the effort of several writers an almost endless number of species and varieties distinguished from **pulchella** by slight variations of shape and color have been recognized in the United States. Since the epidermis of all the Corneocyclades is straw-colored when treated with Oxalic acid to remove the iron salts mechanically deposited in it (doubtless as a protective device), the writer questions whether these cannot all be written as synonyms.

All North America, Europe, Asia.

Los Angeles System: Spring, Garapitos Cañon one-fourth mile above Topanga P. O., Santa Monica Mountains (H. Hannibal); Hemmet's spring, San Francisequito Cañon, five miles south of Elizabeth Lake, Tejon Pass (H. Hannibal); spring one-fourth mile north of German, Tejon Pass (H. Hannibal).

Swamp between Palms and Cienaga, Los Angeles Coastal Plain (H. Hannibal); slough half-mile west of Santa Fé Springs, Whittier (H. Hannibal).

Big Meadows Cienaga, Santa Ana Cañon, San Bernardino Mountains (H. Hannibal); cienaga at forks of Cienaga Seco Creek, Santa Anna Cañon (H. Hannibal); Cienaga Seco,

Cienaga Seco Creek (H. Hannibal); Mill Cañon, Forest Home (S. S. Berry) fide Berry; Mountain Home Gulch, one and one-half miles below Glen Martin (H. Hannibal).

San Jacinto Cañon, South Fork dam, San Jacinto Mountains (H. Hannibal); spring-branch entering Upper Hemet Reservoir from east (H. Hannibal); pond, South San Jacinto Meadows (H. Hannibal).

Spring, North Cuyamaca Peak, Cuyamaca Mountains (Mrs. C. Stephens); Witch Creek (Mrs. C. Stephens); springs, old gold mines (H. Hemphill) fide Cooper.

Arizona System: Vandeventer's Flat, Palm Cañon, San Jacinto Mountains (H. Hannibal); spring one and one-half miles below Vandeventer's Flat on Palm Cañon trail (H. Hannibal).

Carr Cañon, Huachuca Mountains (C. R. Biederman) fide Pilsbry and Ferriss; spring, 7,000′, Carr Cañon (L. E. Daniels) fide Pilsbry and Ferriss; spring, 6,000′, Tanner Cañon (L. E. Daniels) fide Pilsbry and Ferriss; spring, 7,000′, Tanner Cañon (L. E. Daniels) fide Pilsbry and Ferriss; spring, mouth of Ash Cañon (L. E. Daniels) fide Pilsbry and Ferriss; artificial pond, mouth of Hunter Cañon (L. E. Daniels) fide Pilsbry and Ferriss.

Spring-branch, head of Rucker Cañon, Chiricahua Mountains (J. H. Ferriss) fide Pilsbry and Ferriss; Box spring, forks of Rucker Cañon (J. H. Ferriss) fide Pilsbry and Ferriss.

LYMNAEAIDAE.

Lymnaea solida Lea.

Lymnaea solida Lea, Trans. Am. Phil. Soc., VI, 1838, 94, Pl. XXIII, 91; **L. apicina** Lea, loc. cit., 1838, 102, Pl. XXIII, 94; **L. bulimoides** Lea, Proc. Am. Phil. Soc., II, 1841, 33; **Limnaea Adelinae** Tryon, Proc. Phil. Acad. Nat. Sci., 1863, 149, Pl. I, 12; **L. cubensis bulimoides** (and vars.) Hannibal, W. Coast Shells, 1910, 309, Pl. III, 1; **Galba "caperata** Say" F. C. Baker, Mon. Lym., 1911, 225 (in part, north Pacific records); not **Galba "apicina** Lea" F. C. Baker, nor **Galba "apicina solida** Lea" F. C. Baker, loc. cit. 1911, 443ff.—**L. auricularia** L.

While the young of **L. solida cubensis** are indistinguishable from it except by immaturity, the true **L. solida** does not occur in this portion of California and the species is only introduced here to give a clear understanding of the nomenclature which is badly involved. In 1839, the year previous to the publication of **L. cubensis**, Lea described **Lymnaea solida** from the site of the present city of Portland, Oregon. The description is brief and the figure crude, while the copy in Binney's Land and Fresh Water Shells, II, is even more unsatisfactory. However, Lea unmistakably had before him one of the Galbas or smaller Lymnaeas of the **bulimoides-cubensis** group. Since **L. bulimoides** is the only representative found in this region

and agrees reasonably well with the diagnosis, while the authenticity of the locality has never been questioned, it seems necessary to write **solida** in place of **bulimoides** (hence **cubensis** becomes a subspecies). Though **solida** has always been regarded as doubtfully identifiable on account of the bad figure in Binney, **bulimoides** has gone the rounds of the recent literature on this genus.

This change would involve no particular complications but for the fact that within a year a writer unfamiliar with the western Lymnaeas and their ranges has, grossly violating the law of priority, treated **solida** as a variety of **L. apicina,** a synonym according to every writer in fifty years, since it differs but slightly in the elevation of the spire, was derived from the same locality, and described in the same series of articles some months later, and identified the latter with a dwarf form of **L. auricularia** from the Rocky Mountains and Great Lakes. This latter species is not known to occur within several hundred miles of the original locality of **solida,** besides belonging to a different subgenus, **Lymnaea** s.s. An inspection of the muddy photolithographs of the types of **solida** and **apicina** and the specimens identified with them would hardly convince any skeptical conchologist familiar with the group of their specific identity.

Pacific Coast of North America from Alaska to the upper Missouri drainage and middle California, where it intergrades with **L. solida cubensis** which replaces it farther south.

Lymnaea solida cubensis (Pfeiffer).

Limnaea cubensis Pfeiffer, in Wiegm. Arch., I, 1839, 354; **Limnaea techella** Haldeman, Am. Jour. Conch. III, 1867, 194, Pl. VI, 4; **Limnaea bulimoides cockerelli** Pilsbry, Naut. XIX, 1906, 30; **L. "caperata** Say" Berry, Naut. XXIII, 1909, 77; ***L. cubensis** (and vars.) Hannibal, W. Coast Shells, 1910, 308, Pl. III, 4; **Galba bulimoides cassi** F. C. Baker, Mon. Lym., 1911, 221, Pl. XXXVIII, 9-11.

In West Coast Shells **cubensis** was treated as a species but as explained above, its northern variety proves to have been named earlier, hence it must be written **L. solida cubensis.** Several writers have confused this fine **Lymnaea** with **L. caperata.** The latter species ranges from Western Alaska, Hudson Bay, and the lower St. Lawrence basin to Minnesota, Illinois, and Pennsylvania but is absent from the Pacific drainage proper or any point in the Gulf states occupied by **cubensis. L. caperata** may be readily distinguished on comparison by the more elongate shell, rather sub-pupoid spire, and fine epidermal fringes encircling the whorls.

Due to a misunderstanding of its habits this **Lymnaea** has been generally overlooked and consequently records from southern California are few, considering its untold abundance in all the lowland swamps whence it extends up into the moun-

tain valleys. Like the other Galbas or smaller Lymnaeas it is uncommon in lakes and streams; the proper situation to look for it is with **Succinea** in marshy places, particularly on moist tangles of algae.

West Indies and Central America northward to Gulf States, Colorado, and northern California. Along its northern limits west of the Mississippi it intergrades with typical **L. solida.**

Los Angeles System: Near Santa Barbara, foothills of Santa Ynez Mountains (H. Hemphill) fide Keep; (I. B. Hardy); mouth of Cañada Larga, Ventura River Valley (H. Hannibal); Santa Clara River, Montalvo (H. Hannibal); three reservoirs, Bardsdale, Santa Clara River Valley (H. Hannibal) fide Hannibal; Santa Clara River, Filmore (H. Hannibal).

Ballona swamp between Inglewood and Venice, Los Angeles Coastal plain (H. Hannibal); Los Angeles (H. Hemphill) fide Cooper; Compton Creek between Albida and Lynwood (H. Hannibal); Bouton sloughs, Bixby (H. Hemphill), (H. Hannibal); Coyote Slough, La Mirada (H. Hannibal).

Artesian pond near Chino Creek, ten miles south of Ontario, San Bernardino Valley (J. Henderson) fide Henderson.

San Antonio Cañon, two miles above mouth of gorge, Cucamonga Mountains (R. H. Tremper) fide Berry.

Near old gold mines, Cuyamaca Mountains (H. Hemphill) fide Cooper; Warner, San Jose del Vallé (F. W. Bryant).

Morena, San Diego Mesa (C. L. Cass); San Diego (J. S. Newberry) fide Stearns (J. G. Cooper, H. Hemphill) fide Cooper, (C. W. Gripp); Power-house Cañon, San Diego (Mrs. C. Stephens); gulch south of city park, San Diego (Mrs. C. Stephens); fountain, Point Loma (fide Miss M. J. Cook); Rose Cañon, Pacific Beach (C. L. Cass); receiving reservoir of San Diego flume, between La Mesa and Lakeside (H. Hannibal); near International boundary, south of San Diego (H. Hemphill).

Near Alamo, Baja California (C. R. Orcutt) fide Orcutt; Sanzal, Lat. 31°53′ (C. R. Orcutt) fide Orcutt.

Arizona System: Cienaga between Chiricahua and Stein Mountain Ranges, Arizona (H. A. Pilsbry) fide Pilsbry and Ferriss; Salt River, Tempe (E. H. Ashmun); near Holbrook (E. H. Ashmun).

Lymnaea truncatula (Müller).

Buccinum truncatulum Müller, Verm. Terr. et Fluv., II, 1874, 130; **Lymneus humilis** Say, Jour. Phila. Acad. Nat. Sci., II, 1822, 387; **Lymnaeus modicellus** Say, Jour. Phila. Acad. Nat. Sci. V, 1825, 122; **Lymnaea parva** Lea, Proc. Am. Phil. Soc., II, 1841, 33; ***Limnaea humilis** Binney, L. & F. W. Shells N. Am., II, 1865, 63, fig. 99-109; **Limnaea "desidiosa** Say" Dall, Proc. U. S. Nat. Mus. XIX, 1897, 368.

A dwarfish Lymnaea frequent in springs and about streams and moist places in the mountains, often in greenhouses. The

localities give but a partial idea of its probable distribution in this region. The species has passed in the literature under a variety of names; the slender spire, rather inflated whorls, and round aperture are characteristic, however. While generally but 3-5 mm. in length, it often attains a much larger size.

Europe, Siberia; North America south into Mexico and Baja California.

Los Angeles System: Three reservoirs, Bardsdale, Santa Clara River Valley (H. Hannibal); mouth of Santa Ynez Cañon, Santa Monica Mountains (H. Hannibal); Hemmet's spring, San Franciscquito Cañon, five miles south of Elizabeth Lake, Tejon Pass (H. Hannibal); spring, one-fourth mile north of German, Tejon Pass (H. Hannibal).

Green houses, Redlands (S. S. Berry) fide Berry.

Mountain Home Gulch, one and one-half miles below Glen Martin, San Bernardino Mountains (H. Hannibal); San Jacinto Cañon, South Fork dam, San Jacinto Mountains (H. Hannibal).

Near Ensenada, Lat. 31° 51′, Baja California (C. R. Orcutt) fide Orcutt.

Arizona System: Ash Cañon, Huachuca Mountains (Ferriss and Daniels) fide Pilsbry and Ferriss; Santa Cruz River, Tucson (E. A. Mearns) fide Dall.

PLANORBIDAE.

Planorbis trivolvis Say, Nich. Encyc. (1st Ed.) II, 1817, Pl. II, 2; **P. tumidus** Pfeiffer, in Weigm. Archiv., 1839, 354; **P. ammon** Gould, Proc. Bos. Soc. Nat. Hist. V, 1855, 129; **P. tumens** Carpenter, Cat. Reigen Shells, 1857, 181; ***P. trivolvis** Binney, L. & F. W. Shells, N. Am. II, 1865, 115, fig. 194-201: ***P. trivolvis** Hannibal, W. Coast Shells, 1910, 309, fig. 292-3.

An exceedingly variable species common, particularly in ponds and marshy creeks, over nearly all North America and the West Indies. An enumeration of all the names applied to it would require several pages.

Los Angeles System: Artificial pond, hill three miles west of Santa Barbara on Goleta road, foothills of Santa Ynez Mountains (H. Hannibal); Hope Ranch Lake, Santa Barbara (H. Hannibal).

Ballona swamp between Inglewood and Venice, Los Angeles Coastal plain (H. Hannibal); swamp between Palms and Cienaga (H. Hannibal); swamp, Sherman (H. Hannibal); reservoir, hills north of Soldiers' Home (H. Hannibal); Los Angeles (H. Hemphill) fide Stearns; Bouton sloughs, Bixby (H. Hemphill) (H. Hannibal); pond near P. E. R. R. south foot of Signal Hill (H. Hannibal); Willows Creek, Long Beach (H. Hannibal); (extinct) field near Domingues (H. Hemphill); Compton Creek between Albida and Lynwood (H. Hannibal) (Quaternary) Point San Pedro (D. and R. Arnold) fide

Arnold; Laguna between Los Angeles and Whittier (H. Hannibal); Coyote Slough, half way between Whittier and La Mirada (H. Hannibal); Coyote Slough, La Mirada (H. Hannibal); Coyote sloughs below S. P. R. R., between La Mirada and Westminster (H. Hannibal); ditches, Los Alamos sugar-works (H. Hannibal).

Artificial pond, Ontario, San Bernardino Valley (water from San Antonio Cañon) (R. H. Tremper); Bosch reservoir, Ontario (water from San Antonio Cañon) (R. H. Tremper); cienaga, seven miles south-east of Ontario (R. H. Tremper); pond, England Park, Redlands (S. S. Berry) fide Berry; reservoir, mile north of Corona, Temescal Wash (H. Hannibal); Lake Elsinore, Elsinore (Mrs. M. Baldridge) (Mrs. W. F. Ball) (R. H. Tremper) (H. Hannibal); San Jacinto River, Perris, Perris Valley (H. Hannibal); Lower Hemet Reservoir, Hemet, San Jacinto Valley (H. Hannibal); irrigating ditches near San Jacinto (Mrs. C. Stephens).

Upper Hemet Reservoir, San Jacinto Mountains (H. Hannibal).

Near San Diego, San Diego Mesa (Pac. R. R. Sur.) fide Binney; Mission Valley (Mrs. C. Stephens); reservoirs on La Mesa road, four miles east of San Diego (H. Hannibal); La Mesa Reservoir (H. Hannibal); Linda Lake, Lakeside (H. Hannibal); Sweetwater Reservoir (H. Hannibal); reservoir between Upper Otay and Sweetwater Dam (H. Hannibal); Otay Creek, mile below Lower Otay (H. Hannibal); Lower Otay reservoir (H. Hannibal).

Arizona System: (semifossil) Indio, Colorado Desert (R. E. C. Stearns) fide Stearns, (H. Hemphill), (H. Hannibal): (semifossil) New River, Laguna (E. A. Mearns) fide Dall; (semifossil) road between Carrizo Creek and Laguna Mountain below old beach line (Mrs. C. Stephens); (semifossil) near Monument 219, International Boundary (E. A. Mearns) fide Dall.

(Semifossil) Gardner's Laguna, Baja California (E. A. Mearns) fide Dall; (semifossil) Laguna Maquata (C. R. Orcutt) fide Stearns.

Colorado River, Yuma, Arizona, fide Cooper, (E. A. Mearns) fide Dall; Santa Cruz River, Tucson (E. A. Mearns) fide Dall; Seven Wells (E. A. Mearns) fide Dall; irrigating ditches, Phoenix (V. Bailey) fide Stearns; Sonoyta River near International Boundary (E. A. Mearns) fide Dall.

San Bernardino River, near International Boundary, Sonora (E. A. Mearns) fide Dall; San Bernardino River, New Mexico (E. A. Mearns) fide Dall.

Planorbis parvus Say, Nich. Encyc. (1st Ed.), II, 1817, Pl. I, 5; **P. parvus** Binney, L. & F. W. Shells N. Am., II. 1865, 113, fig. 222-3 (not characteristic), not fig. 224 = **S. alba** Müller; ***P. parvus** Hannibal, W. Coast Shells, 1910, 310, Pl. 11, 11;

P. vermicularis of authors, (not of Gould=**P. albus** Müller), many California records.

All North America south to Florida and northern Mexico.

Los Angeles System: Santa Clara River, Montalvo, Santa Clara River Valley (H. Hannibal).

Reservoir in hills north of Soldiers' Home, Los Angeles Coastal plain (H. Hannibal); swamp between Palms and Cienaga (H. Hannibal); Compton Creek between Albida and Lynwood (H. Hannibal); (extinct) field near Domingues (H. Hemphill); (Quaternary) Point San Pedro (D. and R. Arnold) fide Arnold; Coyote Slough below S.P.R.R., between La Mirada and Westminster (H. Hannibal).

Reservoir, mile north of Corona, Temescal Wash, upper Santa Anna Basin (H. Hannibal); Lower Hemet Reservoir, Hemet, San Jacinto Valley (H. Hannibal).

Upper Hemet Reservoir, San Jacinto Mountains (H. Hannibal); pond, South San Jacinto Meadows (H. Hannibal).

Reservoirs, La Mesa road four miles east of San Diego, San Diego Mesa (H. Hannibal); La Mesa Reservoir (H. Hannibal); receiving reservoir, San Diego Flume, between La Mesa and Lakeside (H. Hannibal).

Arizona System: (semifossil) Indio, Colorado Desert (R. E. C. Stearns) fide Stearns; (semifossil) Colorado Desert (Palmer and Carlton) fide Stearns; (semifossil) New River, Laguna (Mrs. C. Stevens).

San Pedro River, Benson, Arizona (J. H. Ferriss) fide Pilsbry and Ferriss.

Planorbis Liebmanni Dunker in Chemnitz, (2 Ed.), 1850, 59, Pl. X, 32-34; **P. gracilentus** Gould, Proc. Bos. Soc. Nat. Hist., V, 1855, 129; ***P. liebmanni** Binney, L. & F. W. Shells N. Am., 1865, 108, fig. 182-3.

A Mexican Species twice recorded from the Colorado Desert. It is possibly cospecific with the West Indian **S. havanensis** which would take priority.

Southern Texas, Mexico.

Arizona System: Colorado Desert (T. H. Webb) fide Gould; (semifossil) New River, Laguna (E. A. Mearns) fide Dall.

Planorbis filocinctus Pilsbry and Ferriss, Proc. Phila. Acad. Nat. Sci., 1906, 165, Pl. IX, 1-3.

San Pedro River, Benson, Arizona (J. H. Ferriss) fide Pilsbry and Ferriss.

PHYSIDAE.

Physa fontinalis (Linné).

Bulla fontinalis Linné, Sys. Nat. (10 Ed.), 1758, I, 727; **Lymnaea heterostropha** Say, Nich. Encyc. (1 Ed.), II, 1817, Pl. I, 6; **P. gyrina** Say, Jour. Phila. Acad. Nat. Sci. II, 1821, 171; **P. lordi** Baird, Proc. Zool. Soc. Lon. 1863, 68; **P. politissima** Tryon, Am. Jour. Conch., I, 1865, 226, Pl. XXIII, 13; ***P.**

heterostropha Binney. (except synonym) L. & F. W. Shells N. Am. II, 1865, 84, fig. 144; **P. Wolfiana** Lea, Jour. Phila. Acad. Nat. Sci., VIII, 1874, 63, Pl. XXI, 20; ***P. heterostropha** Hannibal, W. Coast Shells, 1910, 311, fig. 297.

In the new edition of "West Coast Shells" the writer expressed the opinion that the West American Physas with the exception of **hypnorum**, a boreal species found west of the Rocky Mountains at but a few points, were all referrable to **Physa heterostropha** and **P. heterostropha osculans**, the former northern, the latter southern in distribution. Further studies have in nowise altered these views, but an examination of a considerable series of European Physas has shown conclusively that **heterostropha** is not distinguishable from **P. fontinalis** of northern Europe, while the only safe way to separate **heterostropha osculans** and **P. fontinalis acuta** of the Mediterranean region is by the difference in locality. Since **fontinalis** and its subspecies were named years earlier, the law of priority requires their use in preference to the American names.

Southern California is rather beyond the range of typical **fontinalis** which is uncommon south of the latitude of Monterey Bay. The Physas from this region are referrable to the following subspecies.

Northern Europe; northern North America south to Virginia and middle California, infrequently beyond.

Physa fontinalis acuta (Draparnaud).

Physa acuta Draparnaud, Hist. Moll. Fr., 1805, 55, Pl. III, 10-11; **P. osculans** Haldeman (restr.) Mon. Lim. VI, 1843, Pl. II, 13; **P. mexicana** Philippi in Martini & Chemnitz, 1844, 5, Tab. I, fig. 3-4; **P. humerosa** Gould, Proc. Bos. Soc. Nat. Hist., V, 1855, 128; **P. virgata** Gould, loc. cit. 1855, 128; **P. Traskii** Lea, Proc. Phila. Acad. Nat. Sci. VI, 1856, 163, Pl. XXIV, 80; **P. Gabbi** Tryon, Proc. Phila. Acad. Nat. Sci., 1863, 149, Pl. I, 14; ***P. osculans** Binney, (in synonymy) L. & F. W. Shells N. Am., II, 1865, 85, fig. 146; ***P. heterostropha osculans** Hannibal, W. Coast Shells, 1910, 312, Pl. III, 17.

The straight pillar which distinguishes this subspecies from typical **fontinalis** need not be looked for in specimens less than ten millimeters in length which are not full grown. The character appears only in the adult shell.

Physa is without exception the most widely and abundantly distributed fresh-water mollusk in southern California. No stream, pond, or swamp outside the highest mountains is without it. It is capable of thriving in moist situations flooded but three or four months a year, though unlike the Galbas it is not active except when at least partially submerged.

Mediterranean region and central Europe; North America from Pennsylvania and northern California to southern Mexico and West Indies. Along northern limits it overlaps and intergrades with preceding Physa.

Los Angeles System: Gaviota Cañon, mouth of gorge, Santa Ynez Mountains (H. Hannibal); Glen Anne Creek, Goleta (H. Hannibal); Cameros Creek, Goleta (H. Hannibal); San Pedro Creek, Goleta (H. Hannibal); Marie Ygnacio Creek, Goleta (H. Hannibal); west branch, Atascadero Creek, between Goleta and Santa Barbara (H. Hannibal); artificial pond, hill three miles west of Santa Barbara on Goleta road (H. Hannibal); San Roqui Cañon, mouth of gorge, Santa Barbara (H. Hannibal); small marshy creek crossing Haley Street, north, Santa Barbara (H. Hannibal); Cold Cañon, mouth of gorge, Santa Barbara (Lawton and Hannibal); near Santa Barbara H. Hemphill) fide Keep; Franklin Creek, Carpinteria (H. Hannibal); mouth of Poverty Cañon, Casitas Pass (H. Hannibal); Canada Larga, mouth of gorge, Ventura River Valley (H. Hannibal); Ventura River (C. L. Cass).

Santa Cruz Island (L. G. Yates) fide Yates, (H. Hemphill); (Quaternary) Santa Rosa Island (L. G. Yates) fide Bowers.

Santa Clara River, Montavalo, Santa Clara River Valley (H. Hannibal); Three reservoirs, Bardsdale (H. Hannibal) fide Hannibal; Santa Clara River, Filmore (H. Hannibal); Piru Creek, Piru (H. Hannibal); Santa Clara River, three miles above Camulos (H. Hannibal); Santa Clara River Edison Power Substation near Saugus (H. Hannibal); Soledad Cañon, half mile north of Saugus (H. Hannibal).

San Francisquito Cañon, upper Los Angeles Aqueduct tunnel, Tejon Pass, (H. Hannibal); Hemmet's spring, San Francisquito Cañon, five miles south of Elizabeth Lake (H. Hannibal); Springs, south shore of Quail Lake, (H. Hannibal); spring, old mine between Quail Lake and German (H. Hannibal); spring, one-fourth mile north of German (H. Hannibal); swamp at Gorman Stage Station (E. Palmer) fide Stearns, (H. Hannibal).

Arroya Conejo above Newbury Park, Santa Monica Mountains (H. Hannibal); West Medea Creek, Conejo Pass (H. Hannibal); Bell Cañon one and one-half miles above mouth of gorge, Simi Hills (H. Hannibal); lagoon, mouth of Malibou Cañon (H. Hannibal); Las Virgenes Cañon, lower end of Las Virgenes Valley (H. Hannibal); Malibou Cañon, mouth of Cold Creek (H. Hannibal); Cold Cañon at big bend (H. Hannibal); spring head of Garapitos Cañon (H. Hannibal); Upper Topanga Cañon, one and one-half miles above Topanga P. O. (H. Hannibal); Topanga Cañon, one and one-half miles above mouth of gorge (H. Hannibal); mouth of Santa Ynez Cañon (H. Hannibal); Santa Ynez Cañon, two miles east of Topanga P. O. (H. Hannibal); Lagoon, mouth of Temescal Cañon (H. Hannibal); mouth of Pulga Cañon (H. Hannibal).

Ballona Swamp between Inglewood and Venice, Los Angeles Coastal plain (H. Hannibal); swamp between Palms and Cienaga (H. Hannibal); swamp, Sherman (H. Hannibal); reservoir, hills north of Soldiers Home (H. Hannibal); Los

Angeles River, Tropico (H. Hannibal); Los Angeles River (J. Trask) fide Lea; Los Angeles, fide Binney, (R. E. C. Stearns) fide Stearns, (H. Hemphill) fide Cooper; (extinct) old Plaza fountain, Los Angeles (R. E. C. Stearns) fide Stearns, artificial pond, Eastlake Park, Los Angeles (H. Hannibal); artificial pond, Hollenbeck Park, Los Angeles (H. Hannibal); artificial pond, Westlake Park, Los Angeles (H. Hannibal); Compton Creek between Albida and Lynwood (H. Hannibal); slough mile west of Albida (H. Hannibal); (extinct) Nigger Slough, Gardena (H. Hannibal); (extinct) slough near bend of Compton Creek, Los Angeles-Wilmington road (H. Hannibal); (extinct) field near Dominguez (H. Hemphill); slough between Dominguez and Los Angeles-Wilmington road (H. Hannibal); (Quaternary) Point San Pedro (D. and R. Arnold) fide Arnold; Bixby Slough, Wilmington (H. Hannibal); Willow Creek, Long Beach (H. Hannibal); slough, Willows (H. Hannibal); pond near P.E.R.R., south foot of Signal Hill (H. Hannibal); Bouton Slough, east foot of Signal Hill (H. Hannibal); Bouton sloughs, Bixby (H. Hannibal); Laguna between Los Angeles and Whittier (H. Hannibal); San Gabriel River between Los Angeles and Whittier (H. Hannibal); slough half mile west of Santa Fe Springs, Whittier (H. Hannibal); Coyote Slough, half way between Whittier and La Mirada (H. Hannibal); Coyote Slough, La Mirada (H. Hannibal); Coyote Slough below S.P.R.R., between La Mirada and Westminster (H. Hannibal); artesian reservoir, half mile south of Hansen (H. Hannibal); ditches, Los Alamos sugar works (H. Hannibal); Coyote Creek, Los Alamos (H. Hannibal); Brea Cañon, two miles north of Fullerton (H. Hannibal); Santa Anna River(W. M. Gabb) fide Tryon; Santa Anna River, mouth of lower gorge above Richfields (H. Hannibal).

Artesian pond near Chino Creek, ten miles south of Ontario, San Bernardino Valley (J. Henderson); Bosch Reservior, Ontario (water from San Antonio Cañon) (R. H. Tremper) fide Hannibal; artificial pond, Ontario (water from San Antonio Cañon) (R. H. Tremper); Brown's Reservoir, Ontario (water from Hermosa Cañon) (R. H. Tremper) fide Berry; Cienaga, seven miles southeast of Ontario (R. H. Tremper); irrigating ditches, Redlands (S. S. Berry) fide Berry; reservoir, mile north of Corona, Temescal Wash (H. Hannibal); Coldwater Cañon, Glen Ivy Springs (H. Hannibal); Temescal Wash, mile north of Lee Lake (H. Hannibal); spring, hill north of Lee Lake on Corona road (H. Hannibal); Lake Elsinore, Elsinore (Mrs. M. Baldidge), (Mrs. W. F. Ball). (R. H. Tremper), (H. Hannibal); San Jacinto River, Perris, Perris Valley (H. Hannibal); Lower Hemet Reservoir, Hemet, San Jacinto Valley (H. Hannibal); irrigating ditches near San Jacinto (Mrs. C. Stephens).

San Antonio Cañon, above mouth of gorge, Cucamonga

Mountains (R. H. Tremper) fide Berry; water-trough, 2,000 feet, City Cañon, San Bernardino Mountains (S. S. Berry) fide Berry.

San Jacinto Cañon, South Fork dam, San Jacinto Mountains (H. Hannibal); Upper Hemet Reservoir (H. Hannibal); pond, South San Jacinto Meadows (H. Hannibal).

Jacumbre Hot Springs, Cuyamaca Mountains (Mrs. C. Stephens), (C. L. Cass); Witch Creek (Mrs. C. Stephens); springs, old gold mines, (H. Hemphill) fide Cooper; Potrero Creek (C. L. Cass).

Reservoir, La Jolla, San Diego Mesa (M. Smith) fide Smith, (R. H. Tremper) San Diego (P.R.R. Sur.) fide Gould; (R. E. C. Stearns) fide Stearns, (J. G. Cooper, H. Hemphill) fide Cooper, (W. M. Gabb) fide Tryon, (C. W. Gripp); Switzer Cañon, San Diego (Mrs. C. Stephens); gulch south of City park, San Diego (Mrs. C. Stephens); water-hole near Morena (C. L. Cass); reservoirs on La Mesa road, four miles east of San Diego (H. Hannibal); La Mesa Reservoir (H. Hannibal); receiving reservoir, San Diego flume between La Mesa and Lakeside (H. Hannibal); lily-pond, ridge west of El Cajon Valley on La Mesa road (H. Hannibal); San Diego River, Lakeside Rancho (H. Hannibal); Linda Lake, Lakeside (H. Hannibal); spring branch, Sweetwater River five miles east of La Mesa on Jamul road (H. Hannibal); cienaga, mile north of Spring Valley P. O. (H. Hannibal); Sweetwater Reservoir, (H. Hannibal); Lower Otay Reservoir (H. Hannibal); Dulzura Creek (C. L. Cass); pools, Tia Juana Creek, South of Nelson (H. Hannibal).

Tia Juana Hot Springs, Baja California (H. Hannibal).

Arizona System: (semifossil) Colorado Desert (Webb and Blake) fide Gould, (R. M. Williamson) fide Binney; (semifossil) Indio (Davidson) fide Stearns, (R. E. C. Stearns) fide Stearns, (H. Hemphill), (H. Hannibal); (semifossil) calcareous spring deposit, six miles north of Indio (H. S. Ross); (semifossil) road from Carrizo Creek to Laguna Mountain below old beach-line (Mrs. C. Stephens); (semifossil) well, 45 feet, Walters (Davidson) fide Stearns; (semifossil) Walters (R. E. C. Stearns) fide Stearns, (B. N. Jackson); (semifossil) Dos Palmos (R. E. C. Stearns) fide Stearns; (semifossil) Volcano Springs (R. E. C. Stearns) fide Stearns; creek leading to Colorado Desert (R. S. Williamson) fide Binney; (semifossil) playa south of mouth of Roark Cañon (S. Bowers) fide Bowers; (semifossil) five miles north-west of Brawley (J. S. Hook per J. F. Hook); Cameron's Ranch; near International Boundary (E. A. Mearns) fide Dall; (semifossil) New River, Laguna (E. A. Mearns) fide Dall; Spring near New River (Veach) fide Veach; Palmetto Springs (Mrs. C. Stephens); (semifossil) Monument 219, International Boundary (E. A. Mearns) fide Dall.

Palm Cañon at upper palm grove, San Jacinto Mountains (H. Hannibal): Hog Ranch Cienaga, Mission Cañon, San Bernardino Mountains (H. Hannibal).

(Semifossil) Laguna Maquata, Baja California (C. R. Orcutt) fide Stearns; Hot Springs (H. and C. R. Orcutt) fide Stearns.

Hanlon's Ferry near Fort Yuma, Arizona (C. R. Orcutt) fide Orcutt; Salt River, Tempe (E. H. Ashmun) fide Ashmun; irrigating ditches, Phoenix (V. Bailey) fide Stearns; Crittenden (E. H. Ashmun); Devil's River (W. Loyd) fide Stearns; Seven Wells (E. A. Mearns) fide Dall; Santa Cruz River, Tucson (E. A. Mearns) fide Dall; Big Sandy River (Mrs. C. Stephens).

Cienaga between Chiricahua and Stein Mountain Ranges (H. A. Pilsbry) fide Pilsbry and Ferriss; spring, 6,000 feet, Tanner Cañon, Huachuca Mountains (J. H. Ferriss) fide Pilsbry and Ferriss; Cavalry Camp, Tanner Cañon (W. Mann).

Guadeloupe Cañon, New Mexico (E. A. Mearns) fide Dall; San Bernardino River (E. A. Mearns) fide Dall.

FLUMNICOLIDAE.

Flumnicola sp. indet.

Flumnicola "nuttalliana Lea" Stearns, Shells Death Val. Exped., 1893, 282; **F. "columbiana** Pilsbry" Stearns, Proc. U. S. Nat. Mus. XXIV, 1902, 285.

Nothing further is known of this than contained in these two references. If the locality is authentic the species is probably new since the Flumnicolas are characteristically locallized in distribution and both **F. nuttalliana** = **(virens)** and **columbiana** are not known outside of the Columbia Basin.

Arizona System: (semifossil) Colorado Desert (R. E. C. Stearns) fide Stearns.

AMNICOLIDAE.

Paludestrina protea (Gould).

Amnicola protea Gould, Proc. Bos. Soc. Nat. Hist. V, 1855, 129; **Melania exigua** Conrad, Proc. Phila. Acad. Nat. Sci., VIII, 1855, 269; **Tryonia clathrata** Stimpson, Am. Jour. Conch., 1, 1865, 54, Pl. VIII, 1; ***Paludestrina protea** Stearns, Proc. U. S. Nat. Mus. XXIV, 1902, 227, text fig 1, Pl. XIX-XXI; **P. stokesi** Arnold, Mon. Pleist. Plio. San Pedro, 1903, 305, Pl. VIII, 3; ***P. protea** Hannibal, W. Coast Shells, 1910, 315, Pl. III, 14-15.

As a fossil or semifossil, **Paludestrina protea** occurs abundantly at many points outside its present known limits. Its detection in the living state is fraught with difficulties due to its small size and lacustrine habits, hence future collecting will doubtless considerably increase its existing range.

Michoacan, southern Mexico to Rio Grande River, New Mexico, Bonneville Basin, Utah, and the Snake River, Idaho.

Los Angeles System: (Quaternary) Point San Pedro (D. and R. Arnold) fide Arnold.

Arizona System: (semifossil) Colorado Desert (J. LeConte) fide Conrad;* (semifossil) Grande Jornada (Webb and Blake) fide Gould; (semifossil) Indio (Davidson) fide Stearns, (R. E. C. Stearns) fide Stearns, (H. Hemphill), (H. Hannibal) fide Hannibal; (semifossil) well, 45′, Walters (Davidson) fide Stearns; (semifossil) Walters, (R. E. C. Stearns) fide Stearns, (B. N. Jackson); (semifossil) Dos Palmos (R. E. C. Stearns) fide Stearns; (semifossil) Volcano Springs (R. E. C. Stearns) fide Stearns; (semifossil) near Imperial (H. Hemphill); (semifossil) playa south of mouth of Roark Cañon (S. Bowers) fide Bowers; Flowing Springs (C. R. Orcutt) fide Stearns; (semifossil) road from Carrizo Creek to Laguna Mountain below old beach-line (Mrs. C. Stephens); Fish Springs, fifteen miles north-west of Salton (C. R. Orcutt) fide Stearns; Dos Palmos Springs, six miles north of Salton (C. R. Orcutt) fide Stearns; (semifossil) Monument 219, International Boundary (E. A. Mearns) fide Dall.

Fort Yuma Desert (H. Hemphill).

Paludestrina longinqua (Gould).

Amnicola longinqua Gould, Proc. Bos. Soc. Nat. Hist., 1855, 130; **Pomatiopsis intermedia** Tryon, Am. Jour. Conch., I, 1865, 220, Pl. XXII, 8; **Paludestrina stearnsiana** Pilsbry, Naut., XII, 1899, 124; **P. imitator** Pilsbry, loc. cit. 1899, 124; ***P. longinqua** Stearns, Proc. U. S. Nat. Mus. XXIV, 1902, 284, fig. 2; **P. curta** Arnold, Mon. Pleist. Plio. San Pedro, 1903, 305, Pl. VIII, 2; ***P. longinqua** Hannibal, W. Coast Shells, 1910, 314, Pl. III, 11.

A frequent species in the organic mud of springs, mountain streams, cienagas, and lakes, commonly with Corneocyclas.

Southern Arizona and northern Baja California to northern California and southern Idaho, east to Utah.

Los Angeles System; spring at three gulches, north branch of Bell Cañon, Simi Hills, Santa Monica Range (H. Hannibal).

Swamp between Palms and Cienaga, Los Angeles Coastal Plain (H. Hannibal); near San Pedro, fide Pilsbry; (Quaternary) Point San Pedro (D. and R. Arnold) fide Arnold.

Spring branch, mouth of Mill Cañon (S. S. Berry) fide Berry; mouth of Mountain Home Gulch, Mill Cañon (S. S. Berry) fide Berry; Mountain Home Gulch, one and one-half miles below Glen Martin (H. Hannibal).

Springs, Campo, Cuyamaca Mountains (H. Hemphill) fide Pilsbry; springs, Cuyamaca Peaks (H. Hemphill) fide Pilsbry; Springs, old gold mines (H. Hemphill) fide Cooper; spring, North Cuyamaca Peak (Mrs. C. Stephens).

Arizona System: *(semifossil) Cienaga Grande, Colorado Desert (W. P. Blake) fide Gould; (semifossil) playa south of mouth of Roark Cañon (S. Bowers) fide Bowers; (semifossil)

Indio (Davidson) fide Stearns; (R. E. C. Stearns) fide Stearns, (H. Hemphill) fide Pilsbry, (H. Hannibal); (semifossil) Walters (R. E. C. Stearns) fide Stearns, (B. N. Jackson); (semifossil) Dos Palmos (R. E. C. Stearns) fide Stearns; (semifossil) Volcano Springs (R. E. C. Stearns) fide Stearns; (semifossil) road from Carrizo Creek to Laguna Mountain below old beach-line (Mrs. C. Stephens).

Ash Cañon, Huachuca Mountains (L. E. Daniels) fide Pilsbry and Ferriss; spring, Tanner Cañon (Pilsbry and Ferriss) fide Pilsbry and Ferriss;

Arizona Desert (R. E. C. Stearns) fide Pilsbry.

VALVATIDAE.

Valvata tricarinata (Say).

Cyclostoma tricarinata Say, Jour. Phila. Acad. Nat. Sci. I, 1817, 13; **Valvata sincera** Say, Rep. Long's Exped., II, 1824, 264, Pl. XV, 11; **V. humeralis** Say, New Harm. Diss. II, 1829, 244; **V. virens** Tryon, Proc. Phila. Acad. Nat. Sci., 1863, 148, Pl. I, 11; **V. humeralis californica** Pilsbry, Naut. XXII, 1908, 82; ***V. humeralis** Hannibal, W. Coast Shells, 1910, 316, Pl. II, 6.

Wider experience with this genus has caused the writer to regard all the American Valvatas to be referrable to a single polymorphic species, **tricarinata** of Say. This name is rather a misnomer, however, since the species is only tricarinate in waters surcharged with mineral salts; under normal conditions it is smoothly rounded.

Valvata, though common enough sporadically in central California, Nevada, and Colorado to the northward and in Mexico to the south, has not been recorded from the present area, where it is doubtless infrequent due to the absence of extensive lakes to which it is almost wholly restricted. The species occurs in the San Bernardino Mountains not far from either System in Bear Lake and Bluff Lake Cienaga, but these belong to the Mojave System.

All North America south to southern Mexico.

SUMMARY OF THE FAUNA.

The faunas may be summarized as follows:

Los Angeles System*

*O—present, K—characteristic, L—local only, I—introduced, X—extinct.

	Californian Province proper	Los Angeles System	Arizona System	Baja California System
Anodonta cygnea (Linné)	O	I		
Anodonta cygnea impura (Say)	O	O	O	
Gonidea angulata (Lea)	O	O		
Gonidea angulata haroldiana (Dall)	O	O		
Sphaerium simile (Say)	O	?	O	
Corneocyclas compressa (Prime.)	O	L	O	
Corneocyclas pulchella (Jenys)	O	O	O	O
Lymnaea solida cubensis (Pfeiffer)	O	O	O	O
Lymnaea truncatula (Müller)	O	O	O	L
Planorbis trivolvis (Say)	O	O	O	O
Segmentina parva (Say)	O	O	O	
Physa fontinalis acuta (Draparnaud)	O	O	O	O
Paludestrina protea (Gould)	O	X	O	
Paludestrina longinqua (Gould)	O	O	O	
Valvata tricarinata (Say)	O	—	—	

Of this list ten species may be regarded as constituting an integral part of the fauna. All of these occur in the California Province proper, eight in the Arizona System, while five of wide distribution range south into Baja California.

Arizona System.

	Californian Province proper	Arizona System	Los Angeles System	Sonora System
Anodonta cygnea impura (Say)	O	O	O	O
"Anodonta" dejecta (Lewis)		K		
Sphaerium simile (Say)	O	O	?	
Corneocyclas compressa (Prime)	O	O	L	
Corneocyclas pulchella (Jenys)	O	O	O	O
Lymnaea solida cubensis (Pfeiffer)	O	O	O	O
Lymnaea truncatula (Müller)	O	O	O	L
Planorbis trivolvis (Say)	O	O	O	O
Segmentina parva (Say)	O	O	O	L

Segmentina liebmanni (Dunker).......		O		O
Segmentina filocincta (Pilsbry and Ferriss)............................		K		
Physa fontinalis acuta (Draparnaud)..	O	O	O	O
Paludestrina protea (Gould)...........	O	O	X	O
Paludestrina longinqua (Gould).......	O	O	O	?
Valavata tricarinata (Say)............	O	—	—	O

The Arizona fauna embraces fourteen species of which eleven occur in the Californian Province proper, eight are common to the Los Angeles System, while six of these enter into the Mexican fauna. One Mexican species enters this System, while two species are peculiar.

Coast Range System.

	Coast Range System	Los Angeles System
Margaritana margaritifera falcata (Gould)...	O	
Anodonta cygnea (Linné)..................	X	I
Anodonta cygnea impura (Say).............	O	O
Gonidea angulata (Lea)...................	O	O
Gonidea angulata haroldiana (Dall)..........	O	O
Sphaerium simile (Say)...................	O	?
Musculium lacustre (Müller)................	O	
Musculium partumeium (Say).............	O	
Corneocyclas compressa (Prime).............	O	L
Corneocyclas pulchella (Jenys)...............	O	O
Lymnaea stagnalis (Linné)..................	L	
Lymnaea palustris (Müller)................	O	
Lymnaea solida (Lea)......................	O	
Lymnaea solida cubensis (Pfeiffer)...........	O	O
Lymnaea truncatula (Müller)...............	O	O
Lymnaea sp. nov..........................	K	
Planorbis trivolvis (Say)..................	O	O
Segmentina parva (Say)..................	O	O
Segmentina dilatata (Gould)................	O	
Segmentina alba (Müller)..................	L	
Pompholyx effusa (Lea)...................	L	
Pompholyx newberryi (Lea)................	L	
Gundlachia fragilis (Tryon)................	K	
Physa fontinalis (Linné)..................	O	
Physa fontinalis acuta (Draparnaud)........	O	O
Elimia plicifera (Lea).....................	L	
Paludestrina protea (Gould)...............	X	X
Paludestrina longinqua (Gould).............	O	O
Valvata tricarinata (Say)..................	O	—
"Vivipara" malleatus (Reeve)..............	I	
"Vivipara" japonica (Martyn)..............	I	

The fauna of the Coast Range System which embraces the Coastal Drainage from Mad River to Point Conception, the San Francisco Bay region, Sacramento-San Joaquin Valley, and west slope of the Sierra Nevada Mountains south of Yosemite Valley, is extensive and typically Californian, consisting of twenty-two species and subspecies of which ten extend into and become part of the fauna of the Los Angeles System that adjoins it on the south.

Mojave System.	Mojave System	Arizona System	Los Angeles System
Anodonta cygnea impura (Say)...........	O	O	O
Sphaerium simile (Say)..................	O	O	?
Musculium lacustre (Müller).............	O		
Corneocyclas compressa (Prime)..........	O	O	L
Corneocyclas pulchella (Jenys)..........	O	O	O
Corneocyclas sp. nov....................	K		
Lymnaea palustris (Müller)..............	O		
Lymnaea solida cubensis (Pfeiffer)......	O	O	O
Lymnaea truncatula (Müller).............	O	O	O
Planorbis trivolvis (Say)...............	O	O	O
Segmentina parva (Say)..................	O	O	O
Segmentina dilatata (Gould).............	O		
Pompholyx effusa (Lea)..................	X		
Pompholyx newberryi (Lea)...............	O		
Physa fontinalis acuta (Draparnaud)......	O	O	O
Amnicola micrococcus (Pilsbry)..........	K		
Paludestrina protea (Gould).............	O	O	X
Paludestrina longinqua (Gould)..........	O	O	O
Flumnicola merriami (Pilsbry and Beecher)	K		
Flumnicola erythropoma (Pilsbry)........	K		
Valvata tricarinata (Say)...............	O	—	—

The Mojave System which embraces the Mojave Desert, Bear Valley (San Bernardino Mountains), Owens Valley, Death Valley, and the adjacent desert regions of southern Nevada and south-western California, contains a fauna of some twenty species and subspecies noted for its peculiar operculates. Eight species extend westward into the Los Angeles System and eleven south into the Arizona.

Colorado System.	Colorado System	Arizona System
Anodonta cygnea impura (Say).............	O	O
Sphaerium simile (Say)....................	O	O
Corneocyclas compressa (Prime)............	O	O

Corneocyclas pulchella (Jenys)	O	O
Lymnaea palustris (Müller)	O	
Lymnaea solida (Lea)	O	
Lymnaea solida cubensis (Pfeiffer)	O	O
Lymnaea truncatula (Müller)	O	O
Planorbis trivolvis (Say)	O	O
Segmentina parva (Say)	O	O
Segmentina dilatata (Gould)	O	
Physa fontinalis (Linné)	O	
Physa fontinalis acuta (Draparnaud)	O	O
Paludestrina protea (Gould)	O	O
Paludestrina longinqua (Gould)	O	O
Flumnicola fusca (Haldeman)	L	
Valvata tricarinata (Say)	O	—

The fauna of the Colorado System (basin of the Colorado River above The Needles) has not been thoroughly explored conchologically but contains fully sixteen species and subspecies of which eleven may be enumerated among the fauna of the Arizona System which adjoins it on the south.

Baja California System.

Corneocyclas pulchella (Jenys)	O	O	O
Lymnaea solida cubensis (Pfeiffer)	O	O	O
Lymnaea truncatula (Müller)	L	O	O
Planorbis trivolvis (Say)	O	O	O
Segmentina anitensis (J. G. Cooper)	K		
Segmentina peninsularis (J. G. Cooper)	K		

The fauna of the Baja California System (Baja California Peninsula proper) is extremely impoverished due to the desert-like nature of the country. But six species are known from the region, of which four are common to the Los Angeles and Arizona Systems to the northward. Of these **Lymnaea truncatula** has been obtained only from the higher mountains of the Peninsula.

Sonora System.

The fauna of the Sonora System (streams flowing west from the Mexican Table-land south to the vicinity of Mazatlan) is practically unknown. The following occur or may be expected in this region.

Anodonta cygnea impura (Say)
"Glabaris" glaucus (Valenciennes)
Corneocyclas pulchella (Jenys)
Lymnaea solida cubensis (Pfeiffer)
Lymnaea truncatula (Müller)
Planorbis trivolvis (Say)
Segmentina liebmanni (Dunker)
Physa fontinalis acuta (Draparnaud)

Paludestrina protea (Gould)
Valvata tricarinata (Say)

With the exception of the **Glabaris** all occur in the Arizona System.

Rio Grande System.

	Rio Grande System	Arizona System
(Elliptio?) popei (Lea)	K	
Corneocyclas compressa (Prime)	O	O
Corneocyclas pulchella (Jenys)	O	O
Lymnaea columella (Say)	O	
Lymnaea solida cubensis (Pfeiffer)	O	O
Lymnaea truncatula (Müller)	O	O
Gundlachia rivularis (Say)	O	
Planorbis antrosus (Conrad)	O	
Planorbis trivolvis (Say)	O	O
Segmentina parva (Say)	O	O
Segmentina liebmanni (Dunker)	O	O
Segmentina umbilacatellus (Cockerell)	O	
Segmentina alba (Müller)	O	
Segmentina exacuoa (Say)	O	
Paludestrina protea (Gould)	O	O
Valvata tricarinata (Say)	O	

The fauna of this region presents no particular affinities with that of the Arizona System; only the more widespread species constitute a common element.

Factors of Distribution.

Jordan defines distribution by saying that every kind of animal is found in all parts of the world except where it cannot get, where it has gotten but cannot maintain itself, and where it has gotten but evolved into something else. Dispersal of land animals is the resultant of two factors, **life-zones** or belts of equal temperature and humidity which permit free lateral migration, and **geographic barriers** such as seas to nonmaritime, prairies to arboreal, and deserts to amphibious genera which divide these zones into faunal areas. Water owes its temperature to many influences of which that of the adjacent land-surface is but a factor. An aquatic animal, such as a fish or mollusk, once in a river system, unless the thermal conditions are absolutely prohibitive, will eventually spread over the entire area and multiply at favorable localities regardless of life-zones since its migration is proportionally many times more rapid and not impeded by absence of food and shelter. As a result one of the chief aids in the classifica-

tion of landshell distribution is inoperative except in a broad sense in the study of the aquatic mollusks and, since free dispersal is much less dissected while the barriers which remain are comparatively insurmountable, not to be overcome by fluctuations of temperature and humidity during periods of years, faunal areas become of prime importance.

Much has been written by writers of more philosophical ability than field experience on the natural means of dispersal of fresh-water Mollusca and several theories such as the clinging of gelatinous masses of gasteropod eggs to the feet of aquatic birds have been advanced and passed so frequently in the literature as to have been accepted as an established fact by one or two recent writers. The similar dispersal of the Unionoid glochidia by fish is well known but the dispersal of gasteropod eggs is yet to be proven by an authentic instance. The frequent occurrence of totally unlike faunas in different drainage systems within a comparatively few miles and the fact that there are no instances on record of discontinuous distribution of species which may not be explained more easily otherwise, is proof enough that this means is far less important than these writers would have us believe.

Aquatic mollusks frequently cross barriers never-the-less. In several years' field experience the writer has found perhaps half a dozen undoubted instances which have taken place through natural agencies yet have not gone so far as to have obliterated their clearness. In all cases the means were explainable by a single simple cause, the geological phenomenon of stream-capture—the headwaters of a stream flowing into one drainage system by faulting, tilting of the strata, or erosion becoming transferred to another drainage. The mollusks in these headwaters may then pass freely into the second system providing other agencies do not interfere.

The San Bernardino Mountains afford a typical instance at our very doors. Near the north borders of this Range lies Bear Valley which contains two considerable though shallow bodies of water, Bear Lake and Baldwin Lake. According to the San Gorgonio Topographic Sheet of the U. S. Geological Survey the elevation of Bear Lake which occupies the west and upper end of the valley is about 6750′ above sea level. Toward the east the elevation drops down gradually to Baldwin Lake which has no present outlet but whose surface is 6674′ elevation. This is separated on the east by a ridge 130′ high (according to aneroid determinations made by the writer) from Arrastre Creek which flows to the Mojave Desert. The ridge appears to be the result of a fault running in a north-west, south-east direction between Cashenbury Springs and the old Rose Mine cutting off what seems to have been at one time an extension of the valley opening to the northeast onto the Mojave Desert. As already noted Baldwin Lake has no outlet, it is alkaline. Bear Lake which is little

more than a playa or temporary marsh kept submerged by artificial damming, drains abruptly by a steep narrow gorge rapidly encroaching upon it, Bear Gulch, into the Santa Anna Cañon, thence to the San Bernardino Valley. The fauna of the Santa Anna Cañon, Mill Cañon, and other streams flowing into the San Bernardino Valley from these Mountains is typical of the Los Angeles System and has already been listed. That of Bear Valley and the streams and cienagas emptying into it is entirely distinct, however, but finds close affinities with the fauna of the Mojave System. The species obtained by the writer during a visit in 1910 follow; those marked by an asterisk are absent from the Los Angeles System.

Musculium lacustre (Müller)
Corneocyclas pulchella (Jenys)
*****Corneocyclas** sp. nov.
*****Lymnaea palustris** (Müller)
Lymnaea solida cubensis (Pfeiffer)
Planorbis trivolvis (Say)
Segmentina parva (Say)
*****Segmentina dilatata** (Gould)
Physa fontinalis acuta (Draparnaud)
Valvata tricarinata (Say)

Since the Systems or faunules are founded not on drainage areas but the fauna contained, the writer has felt obliged to treat this valley as an integral part of the Mojave System rather than of the Los Angeles into which it partially drains. As long as Bear Gulch is a precipitous gorge, preventing the immigration of the Los Angeles forms, and the valley below hot and arid, preventing the emigration of the Bear Valley species, a mingling will hardly take place readily.

CONCLUSIONS.

A noticeable feature in the study of the acquatic Mollusca of southern California is the infrequency of species and genera peculiar to lakes, **Paludestrina protea** constituting a noteworthy exception, due to the arid or desert nature of the country which has contributed heartily to the extermination of such forms if they were ever present or became introduced.

The fauna numerous in individuals but constituting only a few species which inhabited the former Lake LeConte now the more depressed portions of the Colorado Desert is of interest showing the adaptation of local species to temporary circumstances. For many years it was supposed that several of these, particularly **Paludestrina protea**, were totally extinct. Careful field-studies have proven the existence of each and all, however, in isolated situations to which they were restricted upon the drying up of the basin. The vast almost unlimited wealth of molluscan life which formerly existed in that region

has been repeatedly described but to be truly appreciated must be actually seen; it is beyond all comprehension.

In a broad sense desert conditions are to aquatic mollusks (and likewise land mollusks) as abyssal conditions are to marine mollusks. Such types naturally enough did not originate in these situations; they are the progeny of bold plastic forms capable of withstanding the energetic physical conditions which must be met by desert life. The sole reason why peculiar desert types have not evolved to a more extensive degree is due to the geologically-speaking temporary nature of deserts. Abysses have existed since life was first known upon the earth, hence have developed a fauna all their own.

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(First record of living fresh-water shells from the Channel Islands.)

Transactions of the Academy

On July 10, 1911, President Spalding appointed the following committees, to-wit:

Program.
Watts, Parsons, Knight.
Finance.
Keese, Baumgardt, Alliot.
Publication.
Collins, Davidson, Benton.

On Monday, July 31, 1911, at the residence of President Spalding in Los Angeles, a reception was tendered to Prof. J. M. Aldrich of the University of Idaho.

Prof. Aldrich gave an interesting account of his investigations as to the fauna of the Salt and Alkaline Lakes of the Great Basin from the Great Salt Lake of Utah westward, and he exhibited many specimens of entomological life, which he had collected and mounted during his explorations.

Directors' Meeting.

A meeting of the Directors was held in the office of the Secretary on Saturday, November 4, 1911. All were present except Parsons, Ulrey and Watts.

The record of the transactions of the Academy as inscribed was presented and approved.

E. O. Essig of Santa Paula, Pingree I. Osburn of Pasadena, F. R. Maulsby, Robert Watchorn and A. W. Wern of Los Angeles were elected members of the Academy.

A communication from Prof. J. C. Branner of Stanford University, relating to the Seismological Society of America, and asking the cooperation of this Academy in its work, was read and the Secretary was directed to inform Prof. Branner that the matter would be presented before the Academy at a future meeting.

As the County Museum and Art Building has been completed and accepted by the Board of Supervisors, and the expense to this Academy will be considerable for the transportation, mounting and arranging of our collections in the wing assigned to us, it was resolved to issue a Circular of general information, concerning the pecuniary necessities of this Academy and solicit Life Memberships and temporary subscriptions to aid in this work, and the matter was placed in the charge of the President and Secretary to institute a mode of procedure in this regard.

Board adjourned.

The Directors held a meeting at the office of the Secretary on Saturday, November 25, 1911. Present, Messrs. Spalding, Keese, Benton, Knight and Collins.

The President reported that the following named persons had agreed to take Life Memberships in the Academy, to-wit: Dr. Norman Bridge, Mrs. G. S. Safford, James Cuzner, Homer Laughlin, Jr., W. A. Cheney, W. A. Spalding, Frank X. Pfaffinger, S. J. Keese, A. B. Benton, J. B. Lankershim.

Mr. W. H. Avery, having paid to the Treasurer, One hundred dollars, was elected a Life Member.

A communication was received from Mr. E. K. Harvey offering to deliver a lecture before the Academy, upon Butterflies. His tender was accepted with thanks, and the Secretary was instructed to make proper arrangements for a meeting in December.

Board adjourned to be re-convened on Thursday, November 30, 1911, at 4½ o'clock P. M.

Academy Meeting.

The regular meeting of the Academy was held on December 16, 1911, in Symphony Hall.

Mr. E. K. Harvey, Member of the National Geographical and Entomological Society, read a paper upon "Butterflies and their interesting Life Histories," and gave some interesting accounts of his experiences with insect life in the tropics.

His collection of the rarest and most beautiful species of the Butterfly Kingdom, representative of all parts of the tropical world and many temperate regions, was placed on exhibition.

Directors' Meeting.

A meeting of the Directors was held in the office of the Secretary on December 30, 1911, a quorum being present.

Eugene J. Fischer and Charles C. Browning, M.D. of Los Angeles were elected to membership.

Mrs. G. S. Safford, W. C. Patterson and Frank X. Pfaffinger, having each paid One hundred dollars, were elected Life Members.

The President reported that the following named persons had agreed to take Life Memberships, to-wit: Myra Hershey, F. M. Coulter, Anstruther Davidson, M. D., J. S. Vosburg, J. Ross Clark.

The Secretary was instructed to make all necessary arrangements for the January 1912 meeting of the Academy.

Board adjourned.

HOLDRIDGE O. COLLINS,
Secretary.

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BULLETIN

OF THE

SOUTHERN CALIFORNIA ACADEMY OF SCIENCES

LOS ANGELES, CALIFORNIA, U. S. A.
JULY, 1912

PLATE 1.
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Vol. XI. Los Angeles, July, 1912. No. 2.

BULLETIN

OF THE

Southern California Academy of Sciences

COMMITTEE ON PUBLICATION:

Holdridge Ozro Collins, LL. D., Chairman.
Anstruther Davidson, C.M., M.D. Arthur Burnett Benton, F.A.I.A.

CONTENTS:

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Nostra Tuebimur Ipsi

Editorial

THE progress made in cleaning, assembling and mounting the fossils from La Brea Rancho is most gratifying, and by September of this year we expect to present for public inspection an exhibit, which will surprise even those who have followed our work and which will convince the public of the great treasures we have exhumed from the zoological graves of the antidiluvium past.

Mr. Raymond D. Jewett and Mr. Eugene J. Fischer have devoted most faithful, conscientious and skilled labor to the mounting of these fossils and the excellent taste and supervision of Mr. Daggett have furnished most appropriate and beautiful desks, standards and cases for the mounts.

At the present time, there stands in all its skeleton ferocity a sabre-tooth tiger six feet two inches in length by three feet in height; the gigantic ground sloth measuring fourteen feet from its snout to the end of its tail standing over nine feet high; a mastodon, thirteen and one-half feet long and eight feet high with the cores of its tusks complete, its skull being seven and one-half feet in circumference; a female bison eleven feet two inches in length and five and one-half feet high; a giant wolf, about the size of the present Alaska timber wolf and resembling in its general build the German and Russian wolf; the skeleton of an African lion of the present day standing close to the sabre-tooth and showing by comparison the great size and strength of the latter. Work upon the male bison is progressing rapidly and, at this time, the

spinal column is mounted thirteen feet in length, and with ribs eighteen inches longer than those of the female. Its skull measures forty-two inches between the cores of the horns, from which an estimate may be made of the enormous spread of these weapons of offense and defense as they once were in all their glory. The elephantus imperialis or imperiator, which exceeded in size the Mastodon and Mammoth, is represented by an enormous humerus and femur, and hopes are entertained that among the tons of unassorted fossils remaining to be examined, enough of the other parts will be found to furnish an entire skeleton.

In the cases are displayed the complete skeletons of a sabre-tooth tiger and giant wolf articulated, with the bones spaced and labelled for examination, and a series of wolf bones of adults and young for study of comparative anatomy.

There are also to be seen the humerus and pelvis of an extinct lion of the African type and we did have the skull, excavated from our concession in the Brea beds, but it has mysteriously disappeared.

It would be tedious to enumerate everything now shown in our Exhibition room, but the cases contain several skulls of the sabre-tooth, the giant wolf; four distinct species of the extinct coyote, skulls and bones of birds and fowls of the air and water and parts of the camel and giant horse.

Although this hall has not been thrown open to the public, Mr. Daggett, the general superintendent, is always glad to welcome any member of our Academy for an inspection of these treasures.

Professor Twining presents the results of some late investigations of the properties of electricity. Ignoring the theory of potential energy, now rejected by all scientists, after a consideration of kinetic energy, the conservation of energy and the known properties of the electron, he advances some theories of his own, the results of many experiments before his pupils and in the quiet of his laboratory, which undoubtedly will attract the attention of advanced students in electricity.

We commend this paper to all who are interested in this branch of Science.

Upon another page is shown an half-tone of two growths which sprang from seeds of the Brownea hybrida, which were brought from India and planted by Mr. H. Herhe in his nursery.

One of them shot up the plant in the ordinary course of seed sprouting, but the other produced its beautiful flower directly from the body of the seed. Whether this "sport" was produced by the stimulus of fungus growth, or from injury by insects is uncertain. The seed, when planted, appeared normal.

We are pleased to announce that Mr. Benton, one of the Directors of this Academy, has been elected a Fellow of the American Institute of Architects.

As this Institute is composed of prominent Architects throughout the United States and it has been very chary in the conferring of this Degree, Mr. Benton is to be congratulated upon securing such an honor, and this Academy will take pride upon having a representative in that very select organization.

Holdridge Ozro Collins.

Wanted

Monthly numbers of Volumes III, IV, V and VI of the Bulletin to complete files. Address the Secretary.

An Investigation into the Nature of the Field of the Positive Charge, and the Direction of Flow of the Electric Current.

By H. LaV. Twining, Professor of Physics and Electrical Engineering, Los Angeles Polytechnic High School.

HISTORY.

IN 1879 Crookes showed that the cathode ray is a stream of negatively charged particles, by causing them to be deflected in an electromagnetic field.

In 1893 Lenard showed that the cathode ray could penetrate an aluminum window through which the atoms could not pass. They were thus shown to be smaller than the atom; i. e. the particles that constitute the cathode ray, are smaller than the atoms of the gas contained in the vacuum tube.

In 1896 Perrin of France showed that the cathode ray imparts negative charges to objects upon which it falls.

In 1897 Lenard and J. J. Thomson definitely showed that the mass of the cathode ray particle is 1-1830 the mass of the hydrogen atom. The cathode ray is also deflected by an electrostatic field.

Millikan, at the Chicago University, recently measured by a unique and accurate method single negative and positive charges and combinations of these charges up to 200 by actual count and found their values in close agreement with those found by others.

In the light of the above results, and also in the light of many other experiments, it has been concluded that the electric current that flows in a metallic conductor consists of a stream of negative charges. The negatively charged particle is called an electron, and it moves at various speeds, depending upon the conditions under which it is placed. In Crooke's tubes it has been found to approach the speed of light, but never has been known to reach it. At one half the speed of light, the electron sensibly increases its mass and when it differs from the velocity of light in the ratio of 1:99999 it has ten times the mass that it has at one half the speed of light. No positive charge has been found flowing in a metallic conductor. Both negative and positive charges are found associated with the atoms in an electrolyte, and when so associated their speed is very slow, being of the order of a few centimeters per hour. In this case they flow in opposite directions. But this flow of ions in an electrolyte does not constitute an electric current, because Hopkins has shown that the speed of the electric current is the same in a metallic conductor and an electrolyte, provided the ohmic resistance of both is the same. A very slight experience with electricity also clearly

shows that the speed of the electrons through conductors is very great.

Rutherford measured the mass and charge of the alpha particle emitted by radium, and found it to be about the mass of the hydrogen atom, and to have a charge equal in value to the charge on the electron. These positively charged alpha particles have been found to be positively charged helium atoms.

Goldstein demonstrated the existence of positive charges in a Crooke's tube. A small hole was pierced in the cathode and positive charges appeared behind the cathode. They were called "canalstrahlen." When measured, the mass of these particles was found to be about the mass of the hydrogen atom and the charge was found to be opposite to but equal in value to the charge of the electron.

Wellisch in the Cavendish laboratory, Cambridge, has lately measured the mass and charge on the particles which constitute the canalstrahlen, when produced in tubes containing different gases. He found this mass and charge to be the same no matter what gas the tube might contain.

Since the atomic weights of the various gases is very different from that of hydrogen or helium, this seems to indicate the existence of a positive entity, having the mass of helium or hydrogen. Whether the actual positive entity is merely contained upon or included in this positive particle, or whether it is a small mass the size of the electron but opposite in charge is not yet known. The fact is however that the smallest positive charge known is atomic in size, consequently it cannot flow through a metallic conductor.

Thus the electron theory of electricity assumes that the electric current consists of a stream of negative charges or electrons. This theory also assumes that the electrons flow from the positive to the negative pole of the battery on the outside of the cell.

A current of electricity or a stream of negative charges sets up an electromagnetic field around the conductor in which it is flowing. The lines of force which constitute this field are assumed to be rotating right-handedly around the wire with their plane of rotation perpendicular to the axis of the wire.

According to the right-hand rule: "If the conductor be grasped in the right hand, the thumb pointing in the direction in which the current is flowing, the fingers encircle the conductor in the direction in which the lines of force are supposed to be rotating."

When a current of electricity or a stream of electrons starts to flow in a conductor near a neighboring conductor, a current of electricity is found to be flowing in the opposite direction to the current in the first named conductor. This current is called an induced current, and the process is known as induction. This process takes place as follows: In Fig. 1 let

AB be a conductor in which a current is flowing in the direction of the arrows, and rising in value. Lines of force E rise out around AB and cut the neighboring conductor CD, setting up a pressure in it, opposite in direction to the current flowing in AB. If CD be a closed circuit, a current will flow in CD in the direction of the arrows. The lines of force E as they cut CD, tear the électrons out of the atoms of the copper and set them to flowing in the direction indicated. When the current in AB becomes steady, the current in CD ceases to flow. It is necessary that the lines of force be moving and cutting at an angle across the circuit CD in order to set up a current in it.

When these lines of force fall in upon AB, they set up a current in CD flowing in the same direction as the current in AB. On account of the above phenomena it is necessary to assume that the lines of force have direction.

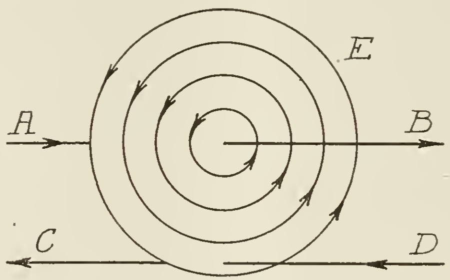

Figure 1.

The nature of the field that exists around a moving negative charge can thus be studied, since the electric current consists of a stream of negative charges. The field about a moving positive charge cannot be studied, because the positive charge does not flow in a conductor, and when it does flow as in an electrolyte, it is always associated with a negative charge, the two flowing in opposite directions. In this case also their movement is very slow, since both charges are associated with atoms. In the voltaic cell and the electrolytic cell, the flow of electrons that constitutes the electric current is also associated with the movement of these charged atoms, or ions.

When the cathode ray or ultra violet light falls upon a gas, the gas becomes ionized. In order to account for this J. J. Thomson assumed that the radiations knock electrons or negative charges out of the neutral atoms. An atom minus an electron then becomes positively charged. The separated electrons associate themselves with neutral atoms. An atom plus the electron is negatively charged.

Thomson thus supposes that the atoms of all elements are made up of electrons on the one hand and a positive portion or matrix, with which the electrons associate themselves. This

positive charge is equal in strength to all of the electrons which it neutralizes: consequently the release of one electron from an atom releases a positive charge equal to the negative charge.

The positive charge is thus always atomic in mass, but the negative charge has a mass 1-1830 the mass of the hydrogen atom. If the positive charges could flow, they would constitute a current of positive electricity, in the same way that a stream of negative charges constitutes a current of negative electricity. It is this stream of negative charges which constitutes the ordinary electric current, the positive charges, being atomic in size, cannot flow through a metallic conductor.

The electric current possesses inertia. This is a property of matter whereby it resists a change from a state of rest or motion. The cause of inertia is not known, but since work has to be done to overcome it, it is reasonable to suppose that it is the resistance offered by the ether to this change. The energy expended in overcoming inertia is stored around the electric current in the lines of force in the ether, which are set up by this change in its rate of flow.

When the current ceases to flow, all of the energy expended in setting up the lines of force is returned to the circuit, as the lines of force fall in upon it. The inertia of the electric current is the same as the inertia of other forms of matter, so far as the energy transformations are concerned, and many leading scientists have surmised that the cause of inertia in both cases is the same.

If the atom is an aggregation of positive and negative charges, then any change in the rate of motion of the atom ought to set up electric fields about these charges, one a negative field and one a positive field and the two would exist side by side and neutralize one another so far as any external influence is concerned.

EXPERIMENT.

Hoping to throw some light upon the nature of inertia, the following experiment was undertaken in the laboratories of the Los Angeles Polytechnic High School. This school has a laboratory equipped for college work in physics and electricity, and it is consequently supplied with the proper apparatus for such work. Messrs. Ed Bennett, Lorenzo Rifenberick and Kenneth Ormiston, members of the electrical engineering class assisted in carrying out the experiment.

As a preliminary trial a coil of wire C, Fig. 2 was prepared. This coil contained one thousand turns of number 34 double cotton covered copper wire. The terminals of the coil were connected to a type P, wall, D'Arsonval galvanometer, made by Leeds and Northrup. It has a sensibility of 31 megohms and a resistance of 148 ohms. A small brass cannon, R, was suspended by wires a couple of inches above the coil C, the muzzle of the cannon being over the middle of the coil. The cannon

had the following dimensions: Length 15.5 centimeters, bore 1.3 centimeters. It was charged with 14 grams of black powder, and a lead bullet weighing 17 grams. The galvanometer G was located some 45 meters away from the cannon R, and the coil C. A slight movement of the coil caused a small deflection of the galvanometer due to its cutting the lines of force of the earth's field. Precautions were taken to see that the coil did not move due to the discharge of the cannon.

Under these conditions no deflection of the galvanometer was produced, when the cannon was discharged over the coil. It was immediately seen that any lines which might arise around the bullet due to its motion, would not only cut the coil at A, but also at B, and thus neutralize the effect produced at A. In order to prevent this an iron core K was introduced into the coil C. If any lines were to swell out from the moving bullet, and cut the coil at A, they would go through into the iron. They would not be able to go on through the iron

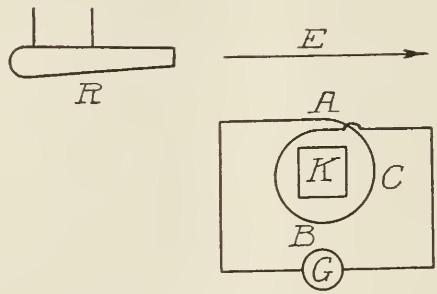

Figure 2.

and cut the other side of the coil at B, because the iron is a good conductor of these lines and they thus prefer the iron path.

Under these conditions on November 4, 1911, a strong deflection of the galvanometer was obtained when a bullet was fired over it. This result was so strong that there was no doubt as to its cause, and more extensive preparations were made in order to study the phenomena.

In order to eliminate any effects due to the iron itself, caused by the magnetization of the iron, a closed core transformer shown in Fig. 3 was arranged.

M is a core of iron, laminated as in a transformer. This core is 18 centimeters long and 17 centimeters wide, outside measure. Each leg is 2 centimeters wide and 3 centimeters thick. The coils C and D were connected so as to oppose one another, so far as the iron was concerned, so that any lines of force swelling out from the bullet, cutting through the coils C and D would set up a current in the same directions in the coils; and, so that any lines of force arising from the molecules

of the iron, as they were arranged by the lines of force from the bullet, would counteract one another in their effects upon C and D. Any inductive effect from the iron would thus be eliminated. Also the iron core could not be magnetized by the current flowing in C and D since they are wound in the same direction around each leg, contrary to what is done in

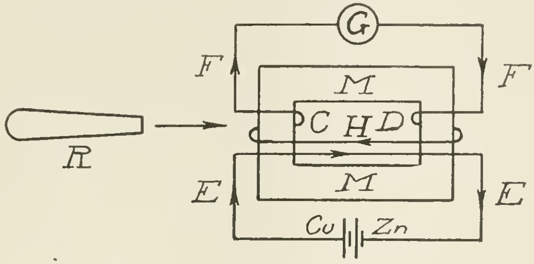

Figure 3.

an electromagnet. The coils C and D contained 8000 turns each of No. 34 enameled wire. All effects due to the presence of the iron was thus eliminated, except the one effect mentioned above. In order to make communication easy between the operators at the cannon and the observer at the galvanometer, the apparatus was arranged as in Fig. 4.

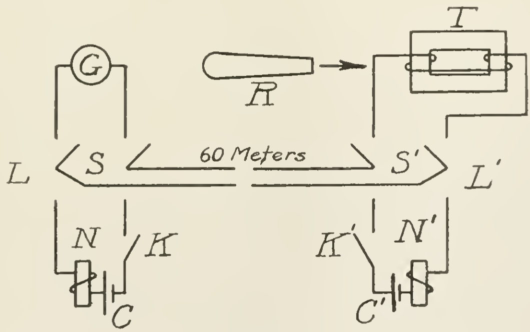

Figure 4.

The galvanometer was located at L in the testing laboratory and the transformer and cannon were placed in the basement of a building, sixty meters distant, at L′. S and S′ are two double throw switches. N and N′ are two telegraph sounders, C and C″ two gravity cells, and K and K′ two keys. From the diagram it is easily seen that the switches can be thrown so as to operate the telegraph instruments or so as to

put the transformer and the galvanometer in electrical connection.

The noise of the discharge of the cannon could just be heard at L, and at every discharge the galvanometer would throw before the noise of the discharge could reach the ear.

The charge of powder and weight of bullet were the same as in the first experiment. One side of the scale of the galvanometer is marked by red figures and the other side by black ones, so that it is convenient to indicate the direction of the deflection by "red" and "black."

A copper wire was stretched over the transformer, see Fig. 3, E, and the ends were connected to the poles of a crowfoot cell, the wire from the copper pole being conducted over the transformer in the same direction in which the bullet was fired. When the circuit was completed, the galvanometer deflected to the black. If the current flows from the copper to the zinc, then the induced current in the transformer would flow in the opposite direction as indicated by the arrow H.

If the galvanometer deflected to the black when the bullet was fired, then it would be acting like a stream of negative charges. If it deflected oppositely then it would indicate a stream of positive charges.

Under these conditions the following data were obtained, on November 17, 1911. The firing commenced at 3:30 P. M. and closed at 4:30 P. M.

TABLE I.

Material fired	Position of Cannon	Deflection of G	Direction	No. of Coils Used	No. of Discharge
Lead	Muzzle over both coils	8 mm	Red	2	1
Lead	Muzzle over first coil	100 mm	Red	2	2
Lead	Muzzle 16 inches away	22 mm	Red	2	3
Lead	Muzzle 2 feet away	19 mm	Red	2	4
Wood	Muzzle over first coil	13 mm	Red	2	5

An examination of the table shows that the discharge of the bullet caused the galvanometer to throw in a direction opposite to that caused by the closing of the circuit of the crowfoot battery, which indicates that the current caused by the bullet and the battery current are flowing in the same direction. Thus the bullet induced a current flowing in the same direction in which it was moving. This result was decidedly unexpected and an explanation will be offered later.

It is to be noted that a wooden bullet gave a strong deflection. This shows that the deflection is not caused by eddy currents due to the bullet, cutting the earth's field. The data also indicate that we are not dealing with inertia effects.

On November 18, 1911, the firing was commenced in the morning and kept up all day. Bullets of different materials were used.

The data obtained on this and following dates are recorded in tables II, III, and IV. In table II the data obtained between eight o'clock in the morning and noon, are recorded. At noon some deflections were obtained toward the red. It is to be noted that the deflections are toward the black, during the morning and opposite to the directions of the deflections obtained in the previous afternoon of the day before and recorded in table I. This result shows conclusively that we were not dealing with effects due to inertia. The time between one and three o'clock was spent in trying to find out the cause of this change in deflections, under what appeared to be unchangeable conditions.

TABLE II.

No. of Discharge	Material fired	Position of Cannon		Def. of Gal.	Direction of def.	No. of Coils	Battery deflection
1	Wood	2 ft. fm. muzzle		90 mm	black	2	black
2	Wood	"	"	25 mm	"	2	"
3	Lead	"	"	6 mm	"	2	"
4	Wood	1st coil un. muzzle		1 mm	"	2	"
5	Wood	"	"	4 mm	"	2	"
6	Lead	"	"	17 mm	"	2	"
7	Rubber	"	"	9 mm	"	2	"
8	Glass	"	"	120 mm	"	2	"
9	Glass	"	"	7 mm	"	2	"
10	Lead	"	"	95 mm	"	2	"
11	Carbon	"	"	260 mm	"	1	"
12	Carbon	"	"	"	"	1	"
13	Lead	"	"	"	"	1	"
14	Carbon	"	"	15 mm	"	2	"
15	Copper	"	"	6 mm	"	2	"
16	Aluminum	"	"	3 mm	"	2	"

The coil used for determining the data of table 3 was a spool of No. 34 double cotton covered wire containing several thousand turns. A core of laminated iron was put into the coil, thus forming an open magnetic circuit. In order to close the circuit iron was stacked around the coil connecting the free ends of the iron.

The object of this was to determine the effect of the iron on the deflections. It will be noticed that experiments 11, 12 and 13 of table II were with one coil only. The galvanometer threw clear off the scale. Lead bullets were used in determinating the data given in table III. An inspection of this table shows that opening or closing the core changed the effect of the bullet upon the deflection of the galvanometer. It had no effect however upon the throw of the galvanometer caused by

opening and closing the battery circuit. The first and second experiments agree with those of the morning but the others show a reversal of them.

Reversing the direction of the bullet over the transformer reversed the deflection of the galvanometer deflection and reversing the connections of the galvanometer reversed the deflections.

TABLE III.

No.	Position of transformer	Connections to gal.	Def. of Gal.	Direction of def.	Open or closed core
1	Original	Original	26 mm	Black	Open
2	Original	Original	50 mm	Red	Closed
3	Reversed	Original	62 mm	Black	Open
4	Reversed	Original	20 mm	Red	Closed
5	Original	Reversed	25 mm	Red	Open
6	Original	Reversed	190 mm	Black	Closed

The non-elimination of the iron introduced a confusing element into the experiment as did the open and closed core. It was found that the same conditions could not be depended upon to produce the same results; consequently the experiment was continued with the arrangement shown in Fig. 4, and about five o'clock the following data were obtained:

TABLE IV.

No.	No. of Coil	Position of transformer	Connections of trans.	Connection to gal.	Def. of gal.	Direction	Battery
1	2	Original	Original	Original	4 mm	Red	Black
2	2	Original	Original	Original	27 mm	Black	Red
3	2	Original	Reversed	Reversed	29 mm	Black	Red

An examination of table II, obtained in the morning shows a reversal of the galvanometer as compared with table I, the data of which were obtained in the afternoon. An examination of table IV shows deflections that agree with those of table I, both tables having been formed in the afternoon. Experiment 1, table IV, is in the original position. Experiment 2 shows that reversing the transformer reversed the direction of the galvanometer, and experiment 3 shows that reversing the connections on the galvanometer also reversed the deflection of the galvanometer. These results when compared with the action of the battery, show that the bullet was acting as though it were a moving charge of electricity. Since the deflections in the afternoon were the reverse of those of the morning, the charge on the bullet must have been different in the morning to the charge on it in the afternoon.

On account of the reversal of the deflections, it was concluded that the friction of the bullets with the air developed electrical charges upon them, and the lines of force rising out from these moving charges caused currents of electricity to be set up in the transformer, as they cut down through the tops of the coils to reach the iron core. If the current in a battery flows from the copper to the zinc, then the charge on the bullet in the afternoon must have been a positive charge, because it produced the opposite effect that was produced by the negative charges, which constitute the current flowing in the battery circuit. The charge on the bullet in the morning would then be negative, because they produced the same inductive effect as the negative charges flowing in the battery circuit. The varying value of the deflections, and the fact that wood, glass, rubber, carbon, copper, aluminum and lead all gave deflections of varying values, shows that we are not dealing with inertia effects, but that we have to do with frictional electricity. The effect due to the earth's field is also disposed of since nonconductors have no currents set up in them when they cut electromagnetic lines.

The charging of the bullets oppositely in the morning and afternoon clearly indicates that the condition of the atmosphere has to do with the phenomena. The air is un-ionized in the morning, and in the afternoon it becomes highly ionized by the continual effect produced by the rays of the sun. The ultra violet light of the sun's rays causes this ionization. Thus the charge on the bullets was due in the morning to friction in un-ionized air and in the afternoon to friction in ionized air. Consequently we might expect that they would charge negatively in the afternoon, due to an excess of electrons in the atmosphere, and positively in the morning due to their absence. Just the contrary happened, however, and the cause of this will be taken up later.

Every precaution was taken to prevent the transformer moving at the discharge of the cannon. The order of the results also show that the deflections were not due to this cause.

By means of this experiment we are able to examine the field existing around a moving positive charge, as well as that around a moving negative charge. These charges were moving swiftly enough to set up electromagnetic fields around the direction of their path, and the results show that the field around the positive charge is rotating oppositely to the field around the negative charge; so that, if we assume that the field around the negative charge rotates right-handedly, then the field around the positive charge is rotating left-handedly, when the charges are moving in the same direction.

On the morning of December 6th an electric storm was in progress. These storms are called northers in this section. The north wind blows, accompanied by dry and electrical con-

ditions. During the progress of such a storm a spark several inches long can be taken off the lower end of an aerial one hundred feet high. This presented an opportunity to test the theory that had been formed as to the cause of the phenomena presented above. If the theory is correct then the galvanometer ought to deflect to the red as it had in the afternoon, because the air was in a highly charged condition or highly ionized. Under these conditions, with the apparatus arranged as in the first experiment, the following table of data were obtained:

TABLE V.

No.	Date	No. of Coils	Material fired	Def. of Gal.	Direction of Def.	Time
1	Dec. 6	2	Lead	7 mm	Red	8:00 A. M.
2	Dec. 6	2	Lead	4 mm	Red	4:00 P. M.
3	Dec. 7	2	Lead	5 mm	Red	8:00 A. M.
4	Dec. 7	2	Lead	10 mm	Red	9:00 A. M.
5	Dec. 8	2	Chalk	10 mm	Red	8:00 A. M.
6	Dec. 8	2	Lead	10 mm	Red	9:00 A. M.
7	Dec. 8	2	Lead	5 mm	Red	3:50 P. M.
8	Dec. 8	2	Water	7 mm	Black	4:00 P. M.
9	Dec. 8	2	Water	8 mm	Black	4:10 P. M.

The electric storm continued throughout the three days indicated in table V and for some time thereafter. The results of this experiment confirmed the results obtained in the previous ones. During the prevalence of this storm the air was highly ionized and consequently the bullet deflected the galvanometer in an opposite direction to that of the battery. This indicates that the bullet was carrying a positive charge. The deflection was the same all day, because the air was as highly ionized in the morning as it was in the afternoon. In experiments 8 and 9 water was used as a bullet and the direction of the galvanometer was reversed.

At this point our transformer became drenched and the experiments were discontinued. No investigation has yet been undertaken to determine why the water should charge oppositely to the other materials employed.

An examination of the above data, in conjunction with the supposition that it is the negative charge that flows brings out clearly the following facts:

1. In the morning the bullet induces a current in the transformer in a direction opposite to that in which it is moving, thus acting like a moving negative charge, since the battery with current from copper to zinc induces a current in the transformer in the opposite direction to which it is flowing, and hence in the same direction as the current induced by the bullet.

2. In the afternoon the bullet induces a current in the transformer in the same direction in which it is flowing, and opposite to what it did in the morning. Since the bullet did not act like a moving negative charge it was acting like a moving positive charge, thus showing that a moving positive charge induces a moving negative charge in the same direction in which it is moving.

The result obtained in 2 is contrary to the generally accepted laws of induction, and we are brought in contact with a new condition and must add another law to the already known one, viz.: A moving positive charge will induce a positive charge in the opposite direction and a negative charge in the same direction in which it is flowing.

The above data indicates that the bullet charges positively in the afternoon. This is contrary to what we could expect. Since the air is highly charged with free electrons in the afternoon, one would think that the moving bullet would collect

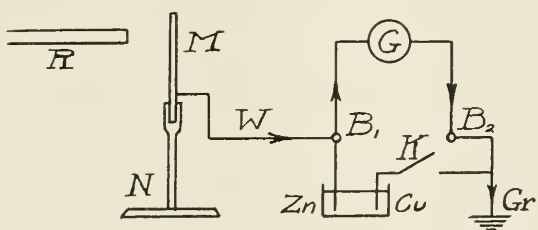

Figure 5.

electrons from the atmosphere and become negatively charged instead of positively charged. Our conclusion that the bullet charges positively in the afternoon rests upon the assumption that the current of electricity flows from the copper to the zinc of a battery in the outside circuit. The above result leads us to think that the assumption as to the direction of the current in a battery may be wrong, and the following experiment was devised in order to demonstrate the direction of the electric current coming from a battery. The same galvanometer was used as in the previous experiment.

As a preliminary, rubbed glass and gutta-percha rods were brought near the galvanometer, when it was unconnected to any circuit. The galvanometer deflected to the black strongly in either case owing to the induced charge upon the case.

When the static machine was connected to the galvanometer and rotated very slowly the same result was produced. After considerable experimenting the following scheme was adopted: In Fig. 5 let M be a metal plate carried on an in-

sulating stand N. Let G be a galvanometer, and B1 and B2 its binding posts. Connect the plate M to the binding post B1 of the galvanometer by a wire W. Connect B2 of the galvanometer to the ground Gr. Rub a gutta-percha rod, R, with cat's fur and bring it near M. In this case the galvanometer deflects to the black. Keep the rod in position, until the galvanometer comes to rest. Upon removing the rod the galvanometer deflects to the red. If a rubbed glass rod is handled in the same way the results are the reverse of those produced by the gutta-percha rod.

The gutta-percha rod is negatively charged. Consequently it has an excess of electrons on its surface. As it approaches M it repels a stream of negative charges through the galvanometer to the ground, deflecting it to the black. As the rod is removed the electrons flow in from the ground to the plate M in order to neutralize the positive charge on the plate, due to the repelling of the electrons from it by R. When the glass rod is brought near, it attracts electrons from the ground, and they flow through the galvanometer to the plate deflecting the galvanometer to the red. When the glass rod is removed the electrons flow from the plate through the galvanometer to the ground, deflecting it to the black.

Now if the cell C be placed on the galvanometer with its zinc Zn, connected to B1, and its copper pole Cu connected through the key K to B2, the galvanometer will deflect to the black, when the key K is closed. B1 and B2 should be connected by a heavy conductor, when the battery is connected in order to prevent injury to the galvanometer. If the battery terminals are reversed the deflections of the galvanometer are reversed.

Thus the zinc pole connected to B1 gives the same result as the negative charge repelled from the plate M by the gutta-percha rod R. Hence a stream of negative charges must be flowing from the zinc through the galvanometer to the copper plate. If the copper plate is attached to B1 and the zinc plate is attached to B2 the reverse takes place. A stream of negative charges flows from the zinc at B2 through the galvanometer to the copper plate, deflecting the galvanometer to the red in the same manner that the negative charges flowing in from the ground on to the plate M causes the galvanometer to deflect to the red.

This experiment shows clearly that the current of electricity flows from the zinc to the copper outside of the cell instead of from the copper to the zinc as has always been assumed.

This galvanometer can be used in this way to plot the field existing around a static machine or to examine the nature of a charge upon any rubbed substance. The deflections of the galvanometer are decided and pronounced, reaching ten to

twenty millimeters. This will work as well on a wet day as on a dry day. In fact it works with as much certainty as any experiment in voltaic electricity. The glass rod must be dry however as it loses its charge easily. We have thus a means for using the galvanometer to measure static electricity with as much certainty as we measure voltaic electricity.

In the light of this experiment the bullet charged positively in the morning and negatively in the afternoon instead of the opposite and this is in line with what we might expect.

This result is also in accord with the flow of ions in a voltaic cell and an electrolytic cell. In Fig. 6 let C be a voltaic cell composed of copper and zinc for electrodes, and hydrochloric acid, ten per cent solution for an electrolyte. The zinc plate charges negatively and the copper plate charges positively. In order to accomplish this result the hydrogen ions travel to the copper plate and charge it positively. The nega-

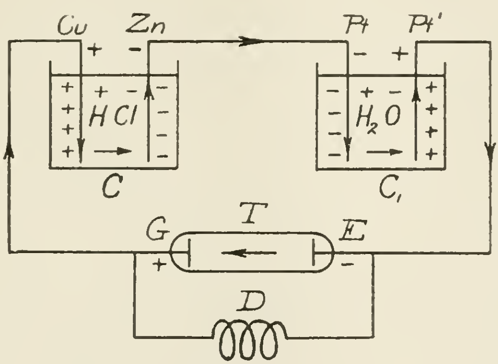

Figure 6.

tive chlorine ions travel to the zinc plate and charge it negatively. Thus the negative charges in the battery are traveling from the positive pole to the negative pole of the cell. Let C1 be a cell containing a dilute solution of sulphuric acid and water. Let the water in this cell be decomposed by the current from the cell C. It is well known that the positive hydrogen ion of the water travels to the negative electrode Pt, and the negative oxygen ion travels in the opposite direction to the positive pole Pt′. therefore the negative ions are traveling in the electrolytic cell in the same absolute direction in the circuit in which they are traveling in the voltaic cell C. Now if the electric current from the cell C which consists of a stream of negative charges is traveling from the copper to the zinc out side of the cell, it is traveling from zinc to copper inside of the cell and opposite to the direction of travel of the negative charges in the cell; but, if on the contrary, the current is

traveling from the zinc to the copper outside of the cell it is traveling from the copper to the zinc inside of the cell, and hence it is traveling in the same direction as the negative charges in the cell.

Let GTE be a Crooke's tube, energized by the secondary D of an induction coil. It is found that the stream of electrons originates at the negative pole of the induction coil, and flows through the tube from the cathode to the anode. This then is also in accord with the idea that the current flows from the zinc to the copper. The current flowing from the zinc pole of C would charge E negatively, and G attached to the copper pole would charge positively. The stream of electrons in the tube is thus flowing from the negative to the positive pole in the Crooke's tube. The electrodes Pt and Pt′ are of platinum.

The conclusions to be drawn from these experiments in the light of our present knowledge are as follows:

1. A stream of negative charges induces a stream of negative charges in the opposite direction in which it is flowing.

2. A stream of positive charges induces a stream of negative charges in the same direction in which it is flowing.

3. A stream of positive charges induces a stream of positive charges in an opposite direction to which it is flowing.

4. If positive charges could flow in a conductor a stream of negative charges would induce a stream of positive charges in the same direction in which it is flowing.

5. Negative and positive charges, if both could flow in a conductor would flow in opposite directions.

6. If the field about a stream of negative charges is rotating right-handedly, then the field about a stream of positive charges is rotating left-handedly, when looking in the direction in which the stream is flowing. Hence their fields are the reverse of each other.

7. Negative and positive charges produce a combined field rotating in the same direction when they are flowing in opposite directions, but if they are forced to flow in the same direction their fields rotate oppositely and oppose one another. Consequently:

8. Opposite charges flowing in the same direction repel each other and like charges flowing in the same direction attract each other.

9. A current of electricity flows from the negative pole of a battery or dynamo to the positive pole in the outside circuit, and in the opposite direction on the inside of the battery or dynamo.

Theory.

The following theory is advanced to account for the above phenomena:

Lines of force are real lines of motion in the ether, either stream lines or wave motion, and when energy is stored in the ether it does not exist there as potential energy, but as the

kinetic energy of motion, the ether itself being supposed to be composed of material particles, oscillating with great rapidity and producing an immense internal pressure within the ether in all directions.

The electron is supposed to be a vortex of ether in the ether, the same as a tornado is a vortex motion of the air in the air; but this vortex that constitutes the electron may be an actual stream of organized ether particles, or it may be an organized wave motion closing in on itself.

Whether this organized whorl has always existed and will always continue to exist, or whether it is continually but slowly disintegrating into the ether and others are continually reforming is not known.

There is an eternal exchange of energy taking place between the ether and the electron. The electrons in the innumerable suns throughout space are radiating their motion out into the ether as electromagnetic waves, light waves or heat waves. These waves differ from one another only in wave length, and frequency. Since they are all due to the electron, they are given the general name of electromagnetic waves. Maxwell showed mathematically, and Lebedew proved experimentally that light waves exert a pressure in the ether. They showed that sunlight exerts a pressure amounting to 0.4 milligram per square meter on a black surface and 0.8 of a milligram on a perfect reflecting surface.

Since it requires expenditure of energy to set up these wave motions, the energy expended must reside in the wave as motion of matter. Work has been done on the ether, and consequently the ether has offered some kind of resistance or no work could have been done upon it. This wave motion cannot exist forever in the ether as such, because light exerts a pressure, and the ether must be opposing some resistance to the continuation of this motion. If it required expenditure of energy to set up the wave, then the wave front will have to expend energy to continue its propogation. This means that the energy of the wave will become dissipated throughout space in time. It will finally degenerate into internal vibratory motion of the particles of the ether.

The electron in the suns of the universe are thus converting the internal vibratory energy of the ether into wave motion in the ether, which in turn degenerates into internal vibratory motion in the ether. As the suns contract, due to the action of gravitation, each electron as it falls toward the center of gravity of the sun acquires from the ether a certain amount of energy due to its fall. On account of the grouping of the electron into atoms, and on account of the close proximity of other atoms this linear motion due to the fall of the electron is converted into vibratory motion, which gives rise to light, radiant heat and electromagnetic waves.

The ether is thus the source from which the sun draws its energy, and the ether is the great reservoir into which the sun again pours this energy but in another form; and the electron is the transformer. The region around a sun thus becomes a region of high pressure and the interstellar spaces are regions of low pressure. As the wave motion disintegrates into internal vibratory motion of the ether, the internal pressure of the ether is raised at that point. An equalization of pressure will then take place between two regions of high pressure.

In Fig. 7, let A and B be two regions of high pressure. Suppose two lines of pressure approach one another laterally as at L. As they come within one another's influence a whorl will be formed, and a little tornado will be established, or a right-handed vortex will originate. A vortex tends to draw material into itself at one pole and discharge it at the other, thus setting up a circulation perpendicular to the plane of the whorl L, For our present purpose suppose this whorl spins out a spiral at right angles to its plane of rotation, proceeding downward into the plane of the paper, the spiral closing in

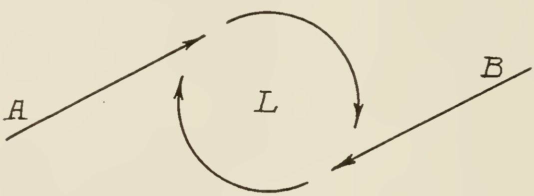

Figure 7.

on itself, so that the spiral forms an endless spiral ring, having the diameter of the whorl for the diameter of the spiral, the diameter of the ring being much larger. This spiral then becomes an organized entity, being composed of a stream line of motion in the ether. This process would relieve the internal pressure in the ether by shearing out of it a portion of itself into a linear motion of particles of the ether in the form of a closed spiral.

This process of pressure equalization at L would result in the formation of a great many of these rings close together, due to a great many filamental lines along which the pressure would be transmitted. The total number produced at any one spot would join together to form an electron, the electron then consisting of a group of these spirals as shown in Fig. 8, which represents a cross section of an electron. Two spiral rings only are shown. The motion of the rings is entering at S and leaving at N. The arrows d crossing the rings show the direction of the rotation of the spiral and the arrows C show the direction of the motion in the ring.

This right-handed electron we shall call a dextron. A left-handed entity would originate in a precisely similar manner. These entities are show in Figs. 9 and 10. These are the only two possible kinds of entities, a right-handed one and a left-handed one. The left-handed one, we shall designate as a levulon. These entities have poles and they are consequently little magnets.

The spiral of the dextron is rotating right-handedly when viewed along its axis from its south pole toward its north pole, and the spiral of the levulon is rotating left-handedly, when viewed along its axis from the south pole toward the north pole.

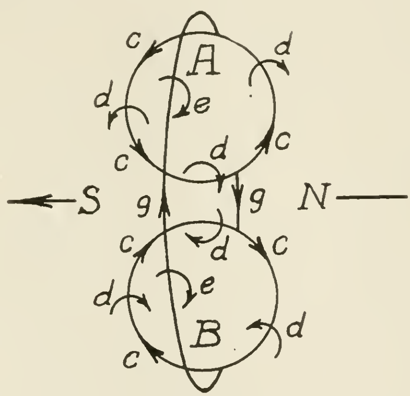

Figure 8.

When these entities are compelled to move through the ether, they will move with their south ends forward because the intake of the entity is at its south pole and its outrush takes place at its north pole.

As the dextron moves with its south pole forward a spiral line of force G Fig. 8 would form around its equator and swell out around it, becoming a part of the dextron and constituting its electromagnetic field due to its motion. This line of force absorbs the energy that is expended in setting the electron into motion and it is this which constitutes its inertia; i. e. the ether offers a resistance to the motion of the dextron through it, which results in this line of force being set up around it, and, the inertia of the electron is proportional to this resistance and to the energy stored in the line of force set up around it. In the dextron this line of force rotates, right-handedly when viewed from its north pole, and the spiral of the line rotates right-handedly when the electron is viewed from the side with the north pole on the right.

In a similar manner the levulon would have a left-handed line of force set up around it when viewed from its north pole, and the motion of the spiral would be lefthanded when viewed from the side with the north pole on the left, as shown in Fig. 10. The dextron is the negative charge or the entity that constitutes the current of electricity, while the levulon is the entity that gives the positive charge to the positive atom. The levulon seems to be atomic in mass, but it may be that the atom is made up of dextrons and levulons in equal number. A negative ion is an atom having a free dextron or an extra dextron, and a positive ion is one lacking a dextron, thus releasing the field of one levulon, which gives the positive charge to the atom. The mass of the levulon and dextron are supposed to be equal as well as their charges.

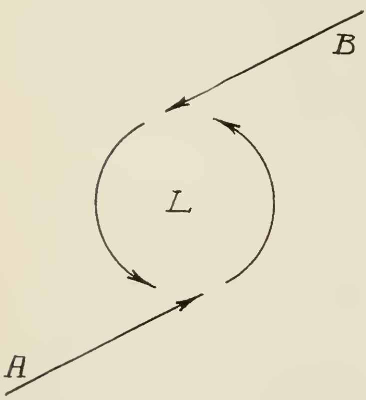

Figure 9.

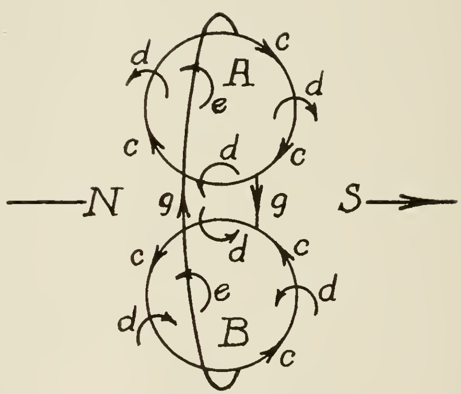

Figure 10.

This theory of the structure of electrons, dextrons and levulons and spiral lines of force accounts for the following facts:

1. Since the dextron is a right-handed entity, the field around it due to its motion rotates right-handedly.

2. Since the levulon is a left-handed entity, the field around it due to its motion is left-handed.

3. The process of induction and self induction is easily explained, if the line of force which arises around these entities, due to their motion, is a spiral line of force instead of a straight line.

4. Free dextrons in an electromagnetic field tend to rotate in a plane perpendicular to the direction of the line. This indicates that the line is a spiral and that the dextron threads its center along the line and hence flows down the spiral.

5. Photographs of electric discharges in a strong electromagnetic field show distinctly spiral structure.

In Fig. 11, let a stream of dextrons or negative charges be flowing from B to A in the conductor BA. Let F and E be the cross-sections of the upper and lower part of the spiral line of force EF, which is swelling out around the current BA due to an increase in its rate of flow. The cross at E indicates that the spiral is moving into the paper away from the observer, and the point at F indicates that the spiral at that point is coming up out of the paper toward the observer. The half of the spiral ring toward the observer is entirely cut away. The arrows at O and O′ indicate the direction of motion of the line that constitutes the spiral. The line of force is thus seen to be a spiral ring swelling out around the current.

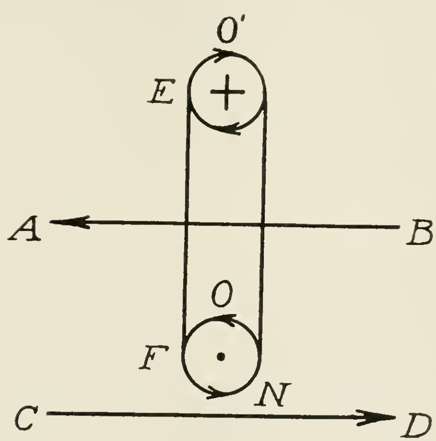

Figure 11.

As this ring swells out and approaches the neighboring conductor CD, the outer part of the spiral at N is moving toward the right as indicated by the arrow at N. Therefore when this plunges into CD, it tears loose a dextron and shoots it in the direction of CD, i. e. in the direction in which it is moving. As it does so the motion of the line EF is absorbed either wholly or in part. If only in part it tears loose other dextrons and it tears them loose until its motion is all absorbed, its motion being converted into linear motion of the dextrons torn loose. As this process takes place, the upper part of the spiral at O does not reach the line CD, because the the spiral delivers all of its motion to dextrons along the arrow at N, before it can do so.

If the current in BA be falling in its rate of flow instead of rising, the line EF falls in upon AB, and if CD is between FN and AB, the point O of the spiral strikes CD first, with

the result that dextrons are torn loose and forced in the direction DC, or in the direction in which the spiral is moving at O, and the motion of the line is absorbed as above. This is in accordance with the well known laws of induction.

This explanation of induction was suggested by Mr. A. N. Hatherell, instructor in physics in the Los Angeles Polytechnic High School.

The tearing loose of the electron is thus a resultant of two motions; one, the swelling out of the line of force in a plane perpendicular to the conductor and the other the motion of the line in a spiral. If the line be still, due to a steady current in BA no induction takes place. The force exerted at O offsets the force exerted at N and no electrons are torn loose.

It must be remembered that the direction of the line of force about the electric current is only assumed. Whether a line of force rotates right-handedly or left-handedly is not known. It is assumed for the sake of convenience that the lines of force rotate right-handedly around the electric current, as one looks in the direction in which the current is flowing. The absolute direction remains to be proven. If the field due to a stream of dextrons rotates right-handedly then the field due to a stream of levulons rotates left-handedly as shown by the transformer experiment.

This transformer experiment also demonstrates that the electric current is a stream of electric charges. Electric charges collect on insulators when rubbed. They also collect on insulated conductors when rubbed. The bullet fired from a cannon is an insulated conductor, if of metal, and insulated also if a nonconductor. When these rub against the air they become charged either negatively or positively. These moving positive or negative charges act exactly like a current of electricity in a conductor; hence the electric current in a conductor is a stream of electric charges.

When these electrons are torn loose from the atoms, it is very probable that one electron only is torn out of a univalent atom, because no matter what the mass of the atom, the positive charge remaining upon it always has the same value. Why the dextron alone is torn out, and the levulon is never torn away, are questions that cannot yet be answered. The number of dextrons torn away depends upon the valence of the atom, and the positive charge remaining or released by the tearing away of the dextrons depend upon the same thing. If it were possible to tear away more dextrons, and also the levulons, the atom would suffer complete disintegration into electrons. Whether this occurs or not we do not know.

Helmholtz and Lord Kelvin assumed a vortex structure for the atom. This would make the atom an indivisible entity, i. e. an entity that would break up into a disorganized mass of particles that constitute the vortex. It may be, however, that

the electrons of the atom are organized into some kind of vortex motion.

According to the theory advanced here the electron is a vortex and Lord Kelvin's theory is merely advanced to the electron. If the electron is made up of an assemblage of smoke ring spirals, it is not an indestructable entity, because it should be possible to separate it into its individual spirals. The spiral would thus be an indivisible entity, and if it were disintegrated, it would dissolve into an unorganized mass of ether particles and cease to be an entity.

Faraday assumed lines of force to be tubes of force but, he did not assign structure to them. Many texts assume that lines of force are merely convenient fictions, like the axis of the earth, but this idea is decidedly illogical. Lines of force are real. They consist of an organization of matter of some kind, because they offer resistance to the passage of a closed conductor through or across them, and a fiction cannot do this.

A New Frasera

A. Davidson, M.D.

Frasera puberulenta, n. sp.

Stout, about one foot high, microscopically minutely and closely puberulent throughout; leaves white margined, radical obovate, tapering to a broad petiole, sickle shaped when folded, 3-5 in. long, ¾ in. wide, cauline 5-6 pairs 1½-2 in. long by ½ in wide, broadly ovate; axillary flowers on long pedicels forming umbellate cymes the whole forming a somewhat open thyrsus; corolla greenish white with conspicuous purple dots above the oblong cordate gland; petals ¼ in. long, oblong, the stout midrib extended to form an acute tip; sepals narrowly lanceolate, nearly one-half longer than the petals.

Easily distinguished from **F. neglecta,** its nearest relative, by the broader leaves, the open inflorescence, the conspicuously nerved petal, and the general puberulence.

Type in authors herb. No. 2705. Hill slope under pines, alt. 9000, South Lake, Bishop Creek, Inyo Co., Cal., July 1911.

See Plate 1, Frontispiece.

PLATE 2.
Brownea hybrida.

An Horticultural Marvel—Flowers Directly from the Seed

H. Hehre.

About a year ago, at my nursery and propagating grounds in Los Angeles, I planted some seeds of "Brownea hybrida," a beautiful flowering tree of India. Six or seven months thereafter, six of these seeds sprouted, and five of them grew into little trees with light green leaves; but the sixth plant developed, immediately from the seed, into a cluster of flowers; one opening first and three subsequently, all on a 2½ inch flower stem. The flowers were 1½ inch long and an inch wide, somewhat in shape like a Crocus, but more slender. There were 5 petals which were red at the base, gradually shading to yellow, and the 12 stamens were yellow. The anthers were golden yellow, and the entire cluster was very beautiful in the shading from red to yellow.

In the tropics, this plant grows to a good sized tree, but the development from these seeds has been very slow, and presents a phenomenon for investigation by the scientific botanist.

Plate 2.

A New Autographa from the Mohave Desert

Fordyce Grinnell, Jr.

Autographa deserta, new species.

Expanse: 32 M. M. Forewings, upperside: decidedly grayish, darker basally, whiter towards the outer margin; ground color black; the white markings following the courses of the wing-veins, giving the insect a much streaked appearance; different from any other form. The usually detached guttiform spot beyond and below the silver is present as a distinct solid white, navicular mark; the silver mark is absent, in its place is a similar marking, above, projecting basally, white, black within; both marks parallel with the costa, veins and other white markings. The claviform is very distinct, large and black within. At the base, parallel with the costa, is a similar mark, white, black within, projecting a little more than half way to the discal signs. The S. T. line consists of a broad series of white streaks extending from the apex to the cell in an inward, decided curve, another series extending from M2 (touching the upper series) to the inner margin, the triangular space above, blackish or rather gray; as is the distinct subterminal space. The terminal line black, distinct. The fringes are very distinctly and sharply cut by black and white alternately. Hind wings pale silvery gray basally, darker scales along the outer margin; a black terminal line; fringes are even white throughout. Underside: an even decided grayish

throughout, with a black discal dash. A pale terminal line; fringes of forewings as on upper side. Head and thorax grayish, corresponding with the adjacent portions of the wings. Abdomen darker.

Habitat: Salt Wells Valley, Kern Co., Calif., Oct. 14, 23, 1909, collected by Leo Goeppinger. Two males; one perfect, the other slightly greasy, but otherwise perfect.

This species although very distinct from any other species is evidently related to **brassicae,** (Riley) (echinocystis, Behr). It is evidently a desert form, very distinct in appearance by the peculiar streaked white wings, and loss of all the dark color of **brassicae.** If it is considered a geographical form, it may be given subspecific rank. As remarked by Grote the guttiform spot beyond the silver mark in **brassicae** is often separate, and here the two distinct white elongate markings of **deserta** are evidently the descendents of these spots.

The Salt Wells Valley is in the Lower Sonoran zone of the Colorado Desert faunal area, with its characteristic assemblage of plants and animals.

A Great Library

Holdridge Ozro Collins, LL.D.

In Venice, that half-oriental City, the mother of famous travelers and adventurous merchants, of patricians and magnificoes enriched by commerce, history was written by her Statesmen and Ambassadors, and her Senate was zealous in seeking the most distinguished authors to compile the Annals of that so-called Republic, but which was in fact a most exclusive and despotic Aristocracy.

The principal and most reliable source from which can be obtained an accurate knowledge of the countries of Europe and Western Asia in all phases of their civic, military, social, commercial and diplomatic conduct of affairs during the middle ages, is the immense collection of manuscripts and early prints, now deposited and most carefully guarded in the building which was formerly the convent or Abbey of that beautiful Church "Santa Maria Gloriosa dei Fratri minori conventuale," in these modern prosaic days designated as the Church of the "Frari," situated in the very heart of Venice, but a short distance from the Grand Canal, and easily reached by gondola.

From this inexhaustible mine Gibbon, Hume, Hallam, Sismondi, Byron, Browning, Ruskin, Thackeray, Victor Hugo, Evans, Crawford, our own Cooper and the innumerable historians, philosophers, poets and writers of fiction of our day, whose works are not for an age but for all time, extracted their treasures of information, and gave us more knowledge of the condition and events of Europe from the 12th Century down to the time of the Reformation, than was known by the people of that period.

In 1496 Marino Sanuto, a Venetian statesman, commenced his famous "Diaries" which he closed in 1535. This journal is contained in fifty-seven folio volumes, and it is considered the most valuable historical production of the Renaissance. "It was a treasure hidden from all eyes for three centuries, but modern historians have drawn largely from it."

In the fourteenth century, Venice, which had always been noted for its religious tolerance, founded a public professorship for the Greek language, and it became a city of refuge for Greek schismatics, towards whom the Roman Church was always hostile. Actuated by this condition of the Church, Cardinal Bessarion bequeathed to the Republic his magnificent collection of Greek manuscripts which, with the manuscripts donated by Petrarch are cherished as the choicest of literary treasures.

No other city could have supplied Aldus Manutius with the facilities for achieving his success in the reproduction of

the master-pieces of Greek literature.—Sophocles, Aristophanes, Herodotus, Thucydides, Xenophon, Plutarch, Plato, Aristotle and Demosthenes, besides a large number of the Latin classics, all of which publications with his imprint, at this day are worth more than their weight in gold.

The origin of Modern Diplomacy is to be found in Venice, and the Venetians acquired their skill in this art of deception —as it was in their day—"from the Byzantines with whom their trade expansion in the Levant early brought them in close contact."

As early as 1236 the Republic "began to lay down a series of rules for the conduct of Ambassadors," among which, they were to deliver a written account of their missions; the replies made to them during their tours of service and anything they might have seen or heard which would be of benefit to the State. These provisions were renewed on several occasions down to 1533, "and they are the origin of the famous reports of the Venetian Ambassadors to the Senate, which are at once a monument to the political genius of Venetian Statesmen and a mine of historical material."

In those days, Diplomacy was frankly Machiavellian and "the ordinary rules of morality were held not to apply in the intercourse between nations. This was admitted in theory as well as in practice."

Germonius, after a vigorous denunciation of lying in general, argues that "it is permissible for the safety or convenience of princes, since *salus populi suprema lex,* and, *quod non permittit naturalis ratio, admittit civilis,*" and he adduces in support of this principle the answer given by Ulysses to Neoptolemus in the Ajax of Sophocles and the examples of Abraham, Jacob and David. An Ambassador was not only a liar *ex officio,* but also an honorable spy, and the famous definition of Sir Henry Wotton—"An Ambassador is an honest man sent to lie abroad for the good of his country," was held to be an indiscreet revelation of the truth.

During the supremacy of the Venetian Republic, her Ambassadors were sent to every nation of Europe and to all the Western powers of Asia bordering upon the Mediterranean, and these Ambassadors were unequaled for their skill in negotiation, their acuteness of intellect, their faculty for gathering information concerning the most secret movements of the governments to which they were accredited and the minute and comprehensive Reports which they transmitted to the Venetian Senate. In only one respect have they been surpassed by the modern Diplomat. The principal of Truth in Diplomatic statements, now prevails in all Christian lands, and accomplishes more than all the intrigue, deceit and lying that characterized the Mediaeval Diplomat.

One case of the labors of an Ambassador may be cited. More has been learned, from the Reports of the Ambassador to England, of the secrets of the English Government and the most obscure events of the private life of Queen Elizabeth during her reign, than can be obtained from any English writer of that day or even from the most private official records of the Kingdom.

These reports, with the immense mass of manuscripts upon History, Music, the Theatre, early Geographical research, Commerce and the judicial and legislative Departments of the Governments constitute the wonderful Archives of Venice. They were formerly scattered or stored in various buildings and small Libraries, but during the time when Venice was annexed to the Austrian Empire, these documents were all collected together and deposited in the Monastery of the Frari and arranged in a fairly convenient order, under the designation of "Imperial and Royal general Archives of Venice." *"Inde fortuna et salus."*

Second only to the Basilica of St. Mark, the Church of the Frari, which dates from 1250, is the noblest building of Venice. No one with the love of the beautiful can view its exquisite interior without being most profoundly moved, and, as Michael Angelo said that the bronze doors of the Baptistry at Florence, by Lorenzo Ghiberti, were worthy to be the gates of Paradise, so may one, standing beneath the vaulted glories of this Church, lose himself in the thought that its grand proportions and exquisite decorations have been transplanted from the architecture of Heaven itself.

This is not the place to enter into any detail of that structure, and I should fail most woefully should I attempt it, but I may refer to the tombs of Doges, Artists and Condottieri erected around its walls, undoubtedly the most beautiful and impressive in Venice. Among them are two by Canova, one to Titian and the other his own famous monument designed by himself, and closely resembling his tomb in the Augustinerkirche at Vienna, erected to the memory of the beloved Arch-Duchess Christine.

Upon my first visit to the Library, and presenting my credentials, I was received with the greatest kindness and courtesy by the Director, and upon the several subsequent occasions of my calls, that gentleman not only extended to me a most cordial welcome, but he threw open to me many places to which there is no open sesame for the idle curious, and he exhibited to me autographs of immortals in History, Art and Song, and exquisitely emblazoned manuscripts on vellum and parchment above all price, to which few have access.

There are nearly 300 vast rooms, chambers and alcoves of all sizes from that of an ordinary office to the two immense halls which were the refectories of the Convent, capable of

seating 1800 monks; galleries extending the entire length of the great Church, and these together scarcely suffice to contain the immense collections of manuscripts. The most noted of these rooms are designated as the Ducal Chancery, the Secret Chancery, the Honor Chancery and the Registers of the Council of Ten. There are over 260,000 portfolios and Registers, together containing over 4,000,000 manuscripts. "Here are chronologically arranged all the papers relating to taxes, the mint, title-deeds, civil and criminal cases and papers concerning finance, the public health, the arsenal, war, sumptuary legislation, maritime possessions, navigation, the arts, trades and liberal professions, the departments charged with the inspection of Monasteries and public services, the ordinary police—under the picturesque name of Signori della Notti al Civili e al Criminale, waters, forests, mines, State loans, communal properties, and a multitude of other *Uffizi* or offices, ramifications of these different great departments."

A noble room, which formerly was the Library of the Monks, now called the Manimorte, is devoted solely to documents relating to control and management of the ancient Convents and Churches.

When these documents were scattered around the city in various buildings, fires destroyed thousands of manuscripts of the different collections. In the sixteenth century, two great conflagrations destroyed a large portion of the manuscripts of the Secret Chancery embracing Diplomatic correspondence from the conquest of Constantinople by the Turks down to the death of Francis I of France, an irreparable loss to history.

After the Conquest of Venice in 1797 Napoleon carried to France many of the Archives, which were subsequently sent to Austria, afterwards compelled to return them to France and they were restored to Venice. Of course in these extensive journeys many must have been lost, stolen or destroyed.

In 1852 when Venice formed a portion of the Austrian Empire, Vienna, coveting the most precious part of these archives, "intended nothing less than to plunder the whole Secret Chancery of Ancient Venice, all the despatches, all the reports, all the diplomatic element which was one of the historic glories of the famous State," but owing to the strenuous exertions of the Cavaliere Mutinelli, at that time Librarian, who was warned of this plot in the regions of imperial power, the hand of Francis Joseph was stayed on the very eve of signing the fatal decree, and it was during the administration of Mutinelli that the first advances were made towards throwing open this immense collection to the student and historian. Up to this time, access to the examination of this collection was practically an impossibility.

The classification and finding lists are perhaps better than any other of the great Libraries of Europe—excluding Eng-

land—but such a thing as a card Index is unknown nor have they anything resembling an Index of subjects, and these deplorable deficiencies prevail generally throughout Italy, Austria, Germany and France.

The great Library of the Vienna University, in which I passed many happy days during the five months of my stay in that lively city, has neither a card index nor an index of subjects. Everything is indexed by authors, in ponderous volumes, and when I first requested a book upon any subject I was invariably asked the name of the author. It was only until I had interviewed the Librarian and explained the character of the books I desired, that he instructed one of his assistants to look up the necessary volumes, and invariably I was compelled to wait at least a day before the books could be found, among their 2,000,000 documents.

To those who desire more extended and minute information concerning the Library of the Frari at Venice I recommend the Work of M. Armand Baschet entitled "Archives de Venise—Chancellerie Secrete de la Republique Serenissime," a volume not generally known in this country, but of considerable historic value, and from which I have drawn for some of the statements in this article.

Transactions of the Academy

Academy Meeting.

The monthly meeting of the Academy was held on January 27, 1912, in Symphony Hall.

The President announced the death of Mr. William H. Avery, whereupon the following memorial was unanimously adopted, viz:

IN MEMORIAM.

The members of the Southern California Academy of Sciences have learned, with sorrow, of the death of one of its most valued members.

William H. Avery departed this life on January 19, 1912, at the City of Los Angeles, when a vigorous old age seemed to promise many years of usefulness. Mr. Avery was a life member of this Academy, and his interest for its welfare and success, and his material aid in all our efforts to extend our influence for scientific investigation were unceasing, and we place upon record our sorrow for the loss of an associate, identified with us in our work for intellectual advancement, and our profound sympathy for those, the depth of whose sorrow cannot be measured by words.

The Biometric Investigation of the Sea was the title of the evening's lecture by Prof. Charles L. Edwards.

The history of his studies of Ocean sea-life, particularly along the California coast, was of absorbing interest, and the stereopticon views were the first of this character exhibited before this Academy.

Directors' Meeting.

The Directors held a meeting in Symphony Hall in the evening of January 27, 1912. Present Messrs. Spalding, Benton, Ulrey, Alliot, Parsons and Collins.

Mr. John S. Vosburg having paid the sum of One Hundred Dollars into the Treasury was elected a Life Member and Mr. J. O. Beebe of 342 West 54th Street, Los Angeles, was elected an associate member.

The Secretary was instructed to have a Home Telephone placed in the office of the Academy.

It was ordered that the names of all persons who shall subscribe for Life Membership, the fee for which is to be paid in instalments, be placed upon the Roll of Associate Members and, in case any of them fail to pay the entire fee for Life Membership, that the amount paid be credited to them on account of dues for ordinary membership.

Board adjourned.

Henry M. Edson, a member of this Academy was killed by a train of the Southern Pacific Railroad Company on January 5, 1912, at Palo Alto, California, intelligence of which was received January 29, 1912.

A meeting of the Directors was held in Symphony Hall on Thursday, February 29, 1912, at 7:30 o'clock P. M. Present Messrs. Spalding, Watts, Keese, Knight, and Collins.

James Cuzner, James B. Lankershim, and Mrs. Erskine M. Ross were elected Life Members of the Academy.

Prof. Charles L. Edwards, A. A. Irish and Tom P. Smith were elected Associate Members.

Board adjourned.

Academy Meetings.

The regular meeting of the Academy was held on February 29, 1912, in Symphony Hall, with a large attendance.

Announcement was made of a meeting of the Astronomical Section, and the following address was unanimously adopted, to-wit:

The Southern California Academy of Sciences gratefully acknowledges the Invitation to attend the celebration of the one-hundredth year of the establishment of The Academy of Natural Sciences of Philadelphia.

We extend to The Academy of Natural Sciences of Philadelphia our most hearty congratulations for its phenomenal success and for the many discoveries in the several branches of Science which have been made through its encouragement and liberality, and which have tended to the advancement of the human race during the last one hundred years.

We, upon this distant Pacific Coast, a very young sister Academy, born but twenty-one years ago, are glad to be able to place upon record at this auspicious event, our appreciation of the work of The Academy of Natural Sciences of Philadelphia, and the good that has resulted from its labors.

A profoundly interested audience listened to the address by Prof. H. LaV. Twining upon Electricity. He dwelt particularly upon the nature of the Electron and induction. The Kelvin vortex rings were demonstrated and practical illustrations were given of the singing, whistling and talking arc, with an exhibition of the X-rays and Crooke's Tubes and many other spectacular experiments with the direct and alternating currents.

A hearty vote of thanks was tendered to the lecturer and his student assistants, at the close of the meeting.

Dr. David Starr Jordan, President of Stanford University, delivered an address upon Eugenics, to a large and intensely interested audience at the regular Academy meeting on April 6, 1912, in Blanchard Hall.

The lecturer took a decided stand in opposition to the Scientific proposition for the governmental control of the marriage relation, and that civilization and all human happiness would be destroyed if man were prohibited from exercising his own will in the choice of his life companion.

The Annual Meeting occurred on June 5, 1912, in Blanchard Hall, a large audience being present.

The following gentlemen were unanimously elected Directors for the ensuing year, 1912-1913, viz: Hector Alliot, Bernard R. Baumgardt, Arthur B. Benton, Holdridge O. Collins, Anstruther Davidson, Samuel J. Keese, William H. Knight, George W. Parsons, William A. Spalding, Albert B. Ulrey, William L. Watts.

In the absence of the President and Vice-President, the Secretary called the meeting to order, and gave a short account of the progress made in the mounting of the fossils from Rancho la Brea, with a statement of some of the improvements consummated and projected in Griffith Park, and the proposed establishment in its mountain table lands of an extensive zoological collection and thereupon the following memorial was unanimously adopted, viz:

The Science of Zoology will be greatly advanced in Southern California by the establishment of Zoological Gardens in Griffith Park and a marine aquarium in San Pedro. The pleasure of the people in the observation of animals, contented and well kept under the charm of life in the open, depends upon a knowledge of the animals and their habits.

Such an Institution will be the Natural History Department of the University of the people that must arise in Los Angeles. The advancement of knowledge by scientific investigation always goes hand in hand with the spread of knowledge by education.

With deep appreciation of the great importance of this Institution to Science and Education, the Southern California Academy of Sciences heartily commends the plans and efforts of the Board of Park Commissioners.

Prof. E. A. Fath of Mount Wilson Astronomical Observatory, who is soon to leave us to assume the direction of the Observatory of Beloit College, Wisconsin, gave us a very graphic description of "A Trip to a Star," visiting our sun and planets, and dwelling for a period among the nebulae. His discourse was illustrated by many photographic views taken by the Mt. Wilson 60-inch reflector.

Directors' Meeting.

The Directors-elect for the ensuing year 1912-1913 met on July 3, 1912, in the office of the Academy.

Present, Messrs. Benton, Collins, Keese, Knight, Parsons, Spalding and Ulrey.

The following Officers were unanimously elected, viz:

President
William A. Spalding.

First Vice-President
Anstruther Davidson.

Second Vice-President
William L. Watts.

Treasurer
Samuel J. Keese.

Secretary
Holdridge O. Collins.

Karl C. Weber, Ford A. Carpenter, David R. Brearley and Arthur D. Houghton, M.D., all of Los Angeles were elected members of the Academy, Mr. Brearley subscribing for a Life Membership to be paid in instalments.

The Board received a Report of a meeting held on June 6, 1912, by certain gentlemen for the purpose of organizing an Entomological Section of this Academy and praying to be recognized and accepted as such; but inasmuch as only three of the gentlemen, identified with said movement, are members of this Academy, the request was refused.

The President appointed the following Committees, to-wit:

Publication

Collins, Davidson, Benton.

Finance.

Keese, Alliot, Baumgardt.

Program

Knight, Parsons, Watts.

The circumstances connected with the work of mounting the Brea Rancho fossils, and the conditions under which they were deposited in the County Museum Building, were presented to the Board by the Secretary, who in his remarks emphatically announced that, in his opinion, this Board of Directors would fail in its duties, and they would be held responsible for the great loss to the Academy, if they failed to assert the title in this Academy, as owners of said fossils, and he exhibited the draft of the following communication and moved that our Representatives be instructed to present the same to the Board of Governors of the Museum and ask that it be made a matter of record in their proceedings, to-wit:

Los Angeles, July 3, 1912.

To the Board of Governors of the Los Angeles County Museum of History, Science and Art: You are hereby notified that all of the fossils excavated from La Brea Rancho, which are now in the Museum Building at Exposition Park, are the property of the Southern California Academy of Sciences, and that this Academy claims to be, and is the sole and exclusive owner of said fossils:

That said fossils were excavated under the direction of this Academy of Sciences, which paid all the expenses thereof, from its individual Treasury, amounting to over \$2,000, under a concession to it by Mrs. Erskine M. Ross.

In signing the Contract with the Historical Society of Southern California, The Fine Arts League, The Southern Division of the Cooper Ornithological Club, and the County of Los Angeles, this Academy of Sciences did, in no respect, relinquish its title to said fossils, and it has at no time consented to any proposition relating to the waiving of its title to said fossils.

It is not the intention, at this time, to remove said fossils from said Museum, or to take them from the supervision of your Board of Governors, but we make this statement, that you may understand our claims in the premises, and we ask that this communication be incorporated in the record of the meeting at which it shall be presented to you, so that in the future,—perhaps a very distant future,—there may be no misunderstanding, should this Academy of Science demand possession of said fossils for the purpose of depositing the same in its own Building.

The Board of Directors of the Southern California Academy of Sciences, at a meeting held on July 3, 1912, ordered this Communication to be presented to you by its Representatives upon your Board with the request that it be made a matter of record in your proceedings.

An extended discussion ensued, and while it was the unanimous expression of opinion that some measures should be adopted to obtain a permanent record of the ownership of said fossils by this Academy, by consent of the mover, action upon said motion was deferred, and the mat-

ter was given to our Representatives in the Board of Governors for consideration as to the most feasible means of obtaining the record desired.

It was resolved that this Board in a body, visit the Museum Building on Monday, July 8, 1912, and inspect the fossils and the work, now in process of their assembling and mounting.

The Board adjourned to 12:30 P. M. of Monday next.

On Monday, July 8, 1912, all the Directors, except Messrs. Alliot and Baumgardt, proceeded to the Museum Building and passed a most instructive and pleasant afternoon in the inspection of the work upon the Brea fossils and the mounts now in place in the large hall.

The work accomplished and in progress was found to be most satisfactory, many thousands of objects in zoology, conchology, ichthyology, entomology and ornithology having been assembled, scientifically classified and arranged for exhibition in cabinets, drawers, cases and stands of the latest designs and improvements.

At the close of the inspection, a business meeting was held in the Directors' room, at which matters of importance relating to the welfare and supervision of these collections were considered and discussed.

Mr. Frank S. Daggett was elected a member of the Academy and a hearty vote of thanks was tendered to him and his assistants, Messrs. Jewitt and Fischer, for their attention and courtesy.

Board adjourned.

HOLDRIDGE OZRO COLLINS,
Secretary.

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